

HP StorageWorks Auto LUN XP user's guide

XP48
XP256
XP512

second edition (February 2004)

part number: B9340-96002

This guide explains how to install and use the Auto LUN XP application



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HP StorageWorks Auto LUN XP: Users Guide

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About this guide	7
Intended audience	7
Disk arrays	7
Related documentation	7
Conventions	8
Getting help	9
HP technical support	9
HP storage website	9
HP authorized reseller	10
Revision history	11
Warranty statement	12
1 Introduction	15
Overview of Auto LUN	16
Monitoring	17
Estimating	20
Reserving volumes	20
Manual migration	20
Auto migration	23
Creating an auto migration plan	25
2 Installation	29
Installing Auto LUN	30
Before starting the installation	30
Auto LUN requirements and restrictions	31
Installing the Auto LUN option license key (XP256)	33
Installing the Auto LUN option software key (XP512/XP48)	34
Uninstalling Auto LUN	36

3 Operation 37

- Starting Auto LUN 38
- Auto LUN Main window 39
- Monitoring operations 42
 - Starting and stopping monitoring 42
 - Selecting the monitoring data term 44
 - Saving monitoring data to disk 45
- Viewing the volume usage rate 46
- Reserving volumes 47
- Performing manual migration 49
 - Starting manual migration 51
 - Checking manual migration status for source and target volumes 54
 - Stopping manual migration 55
- Performing automatic migration 56
 - Setting or resetting fixed parity groups 60
 - Setting the maximum disk usage 61
 - Setting the evaluating schedule and migration time 64
 - Making a new automatic migration plan 67
 - Canceling an auto migration plan 69
- Viewing the migration history 70
 - Viewing the manual migration history log 70
 - Viewing the auto migration history log 71
 - Migration history log entry formats 72
 - Migration history log entry fields 73
- Making a graph of Auto LUN monitoring data 76
 - Excel installation 76
 - Making a graph using Excel 77

4 Installing and using GraphTool 79

- Using GraphTool to analyze monitoring data 80
 - Analyzing MP usage 80
 - Analyzing I/O statistics 81
 - Analyzing LDEV-specific data 81
- Installing and uninstalling GraphTool 82
 - Installing the GraphTool software 82
 - Viewing the GraphTool version information 84
 - Uninstalling the GraphTool 85
- Starting and Exiting GraphTool 86

GraphTool main window	87
File menu	88
View menu	88
Configuration menu	88
Window menu	89
Option menu	89
Help menu	89
Toolbar	90
Extracting the data from the log file	91
Extracting log data on floppy disk	92
Extracting log data on the hard disk	95
Specifying the default log data directory	95
Displaying the graphs	97
Selecting the data module	100
Selecting the parity group	101
Selecting the data term	102
Selecting the units (LDEVs)	104
Viewing the graphs	105
Example Disk Utility (Parity Group) module line graph	106
Example Disk Utility (LDEV) module stacked area and line graph	107
Example CHP, DKP, DRR, and Path Utility module line graph	108
Highlighting specific data on a graph	109
Changing the data term, step, and plotting mode of a graph	111
Changing the LDEVs on a graph	112
Changing the font on the graphs	113
Exporting data to text files	114
Graph data export procedure	116
Printing the graphs	118
Closing the graphs	119
5 Troubleshooting	121
Failure to make a plan	122
Failure to execute a plan	122
Error codes	123
Contacting HP customer service	128
Glossary	129
Index	133

About this guide

This manual explains how to install and use the HP StorageWorks Auto LUN XP software. This software runs on the remote console PC which connects to and controls HP Surestore and StorageWorks disk arrays.

Intended audience

This guide is intended for use by system administrators who already have expertise with the associated systems, software, and related topics:

- Data processing concepts
- Direct-access storage device subsystems and their basic functions
- Disk arrays and RAID technology
- Operating system commands and utilities

Disk arrays

Unless otherwise noted, the term *disk array* refers to any of these products:

HP Surestore Disk Array XP256
HP Surestore Disk Array XP512
HP Surestore Disk Array XP48

Related documentation

HP provides the following related documentation:

- *HP Surestore Disk Array XP48: Owner's Guide*
- *HP Surestore Disk Array XP256: Owner's Guide*
- *HP Surestore Disk Array XP512: Owner's Guide*
- *HP StorageWorks Remote Control XP for XP Disk Arrays: User Guide*
- *HP StorageWorks LUN Manager XP for XP Disk Arrays: User Guide*

For information about operating system commands and third-party products, refer to the manufacturer's documentation.

Conventions

This guide uses the following text conventions.

Figure 1	Blue text represents a cross-reference. For the online version of this guide, the reference is linked to the target.
www.hp.com	Underlined, blue text represents a website on the Internet. For the online version of this guide, the reference is linked to the target.
literal	Bold text represents literal values that you type exactly as shown, as well as key and field names, menu items, buttons, file names, application names, and dialog box titles.
<i>variable</i>	Italics indicates that you must supply a value. Italics is also used for manual titles.
<code>input/output</code>	Monospace font denotes user input and system responses, such as output and messages.
<i>Example</i>	Denotes an example of input or output. The display shown in this guide may not match your configuration exactly.
[]	Indicates an optional parameter.
{ }	Indicates that you must specify at least one of the listed options.
	Separates alternatives in a list of options.

Getting help

If you still have a question after reading this guide, contact an HP authorized service provider or access our website:

www.hp.com

HP technical support

In North America, call technical support at 1-800-652-6672, available 24 hours a day, 7 days a week.

Outside North America, call technical support at the nearest location. Telephone numbers for worldwide technical support are listed on the HP website under support:

thenew.hp.com/country/us/eng/support.html

Be sure to have the following information available before calling:

- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions

For continuous quality improvement, calls may be recorded or monitored.

HP storage website

The HP website has the latest information on this product, as well as the latest drivers. Select the appropriate product or solution from this website:

thenew.hp.com/country/us/eng/prodserv/storage.html

HP authorized reseller

For the name of your nearest HP authorized reseller, you can obtain information by telephone:

United States 1-800-345-1518

Canada 1-800-263-5868

elsewhere See the HP website for locations and telephone numbers:
www.hp.com

Revision history

September 1999	Open-8 emulation added.
January 2000	Content extensively revised and reorganized.
June 2000	Added support for XP512. Content reorganized and revised.
February 2001	Added appendixes B, C, D, and E. Added glossary.
February 2004	Added button name changes in main window, new graphing features, and text improvements.

Warranty statement

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Introduction

Auto LUN XP is an optional software application that runs under the HP StorageWorks Remote Control XP (RC) software application on the remote console PC. Auto LUN XP (Auto LUN) enables you to monitor and optimize data storage and retrieval on the disk array to achieve disk load balancing and reduce bottlenecks. Using Auto LUN you can obtain detailed information about physical disk drive usage, optimize logical volume allocation, and perform RAID level configuration.

Overview of Auto LUN

The Auto LUN XP software runs on the remote console PC and enables you to monitor and manually or automatically optimize volume allocation of the attached disk arrays. The software also maintains and displays a history log of Auto LUN operations.

The disk array can contain several hard disk drive sizes and both RAID1 and RAID5 technologies, including a mix of RAID1 and RAID5 array groups. The combination of RAID level and physical drive type optimizes disk array performance for your environment.

Auto LUN provides the following functions:

- The Monitor function monitors and displays the utilization of disk array resources. Graphing software included with Auto LUN displays the data graphically to highlight peaks, trends, and bottlenecks.
- The Estimate function estimates the utilization of parity groups after a proposed Auto LUN migration of logical volumes.
- The Reserve Volumes function reserves target volumes for migration operations.
- The Manual Migration function immediately moves logical volumes to specified parity groups.
- The Auto Migration function creates a migration plan based on the information you enter and then moves the logical volumes automatically according to your specified migration plan.

Monitoring

Auto LUN monitoring enables you to evaluate disk array resource usage and determine whether resources are overloaded or out of balance. The Disk Controller (DKC) of the disk array performs the monitoring function. Monitoring is disabled by default and must be started as explained in [Chapter 3 \(page 37\)](#) to let the DKC begin collecting monitoring information. Monitoring continues until it is explicitly stopped.

Auto LUN monitoring displays usage information for the following disk array resources:

- ACP (array control processor) microprocessors and DRRs (disaster recovery and regeneration processors)
- (XP256) F-buses and M-buses
- (XP512) AccessPath
- CHIP (Client-Host Interface Processor)
- Parity groups

Usage (time in use) of all logical volumes in a parity group. The parity group usage is the sum of the logical volume usages for all volumes in the parity group.

- Logical volumes

Usage (time in use) of each logical volume in a parity group, including synchronous and asynchronous access, averaged by the number of physical drives in the parity group.

Monitoring information is collected from the DKC once every 12 hours at a time you specify and is stored on the hard disk of the SVP. When you start Auto LUN, you can gather the latest monitoring data from the current 12-hour period that has not yet been transferred to the SVP. The SVP maintains monitoring data for up to three months and overwrites the oldest data. You should export the data periodically if you need to retain it longer than three months.

The monitoring data displays in percentages that represent the percentage of time the resource is active (non-idle) during the monitoring term (period). Usage is monitored and recorded in 15 minutes intervals. Each

recorded value represents a data point in the monitoring term. The “Average Utilization” value is the average across all data points for the specified monitoring term. The “Maximum Utilization” value is the highest usage percentage across all data points for the specified monitoring term.

Auto LUN allows you to configure, start, and stop the monitoring and collection of disk array usage data. You can also specify the monitoring data term (range of data) to be displayed. In addition, you can export monitoring data for use in other applications. The Auto LUN GraphTool allows you to view the exported monitoring data in a graphical format.

Evaluating disk array performance

You use Auto LUN monitoring to evaluate various aspects of disk array performance:

ACP and DRR processor usage

If Auto LUN monitoring shows that overall Array Control Processor (ACP) or Data Recovery and Regeneration (DRR) processor usage is high, consider installing additional ACP pairs or hard disk drives (HDDs), then migrate the logical volumes that had high write-access usage (especially sequential writes) to the new parity groups. If Auto LUN monitoring shows unbalanced ACP usage, migrate logical volumes under the high-usage ACP pair to parity groups under the low-usage ACP pair.

Auto LUN cannot estimate ACP usage. Therefore, use Auto LUN migration to correct high or unbalanced ACP usage only for obvious cases; for example, whenever a slight difference of each ACP utilization occurs or if DRRs are used frequently.

RAID (parity) group usage

If Auto LUN monitoring shows high parity group usage, consider installing additional HDDs and migrating the high-usage logical volumes to the new parity groups. If Auto LUN monitoring shows that parity group usage is unbalanced, migrate logical volumes from high-usage to low-usage parity groups.

Bus usage (*XP256 only*)

Auto LUN monitoring displays F-bus and M-bus usage information, but Auto LUN migration operations do not address and do not improve bus usage. The F-buses and M-buses are common resources within the disk array. If you suspect disk array performance is being affected by high or unbalanced bus usage, contact your HP representative.

CHIP usage

When Auto LUN monitoring shows high usage for all Client-Host Interface Processors (CHIPs) in the disk array, the CHIP resources are overloaded. Consider installing additional CHIP pairs. If Auto LUN monitoring shows CHIP usage is not balanced, consider reconnecting the channel paths of the overloaded CHIPs to a different channel adapter board containing CHIPs with lower usage levels.

Considerations for disk array performance

Auto LUN tuning methods must be applied to achieve overall improvement. Improvement will decrease when there is a slight difference in utilization of each parity group, or if DRRs or ACPs are in comparatively high use. Errors present in the system can increase or unbalance use of system resources.

When you make changes to balance loads, performance of the total system or individual resources may improve at the expense of other resources. For example, suppose RAID groups A and B utilize 20% and 90% respectively. After you move a logical volume from parity group B to parity group A, utilization of A and B becomes balanced at 55% each. This change improves the I/O response time of B because its load has decreased from 90% to 55%, but also degrades the I/O response time of A because its workload has increased from 20% to 55%. The tradeoff may be worthwhile to achieve approximately equal loads and response times for A and B, but the negative effect on A should be anticipated.

Estimating

The Estimate function lets you estimate the anticipated use of parity groups after a proposed Auto LUN migration of logical volumes. You estimate the projected changes in parity group and logical volume utilization based on the disk array monitoring data. The Move Volume window displays the actual volume usage rate of each target parity group and the estimated volume usage rate after migration.

Reserving volumes

The Reserve Volume function allows you to select and reserve target volumes for migration operations. During migration, Auto LUN maintains the specified number of reserved volumes by changing source volumes to reserved volumes as the original reserved volumes are used.

Manual migration

The Auto LUN Manual Migration function lets you take full control of Auto LUN tuning operations. While auto migration operations are based only on disk usage and the hierarchy of parity groups, manual migration operations can be based on back-end processor usage (DKPs and DRRs) as well as volume and parity group usage. If Auto LUN monitoring shows high or unbalanced processor usage, you can use manual migration operations to tune the processor performance of the array.

Manual migration steps

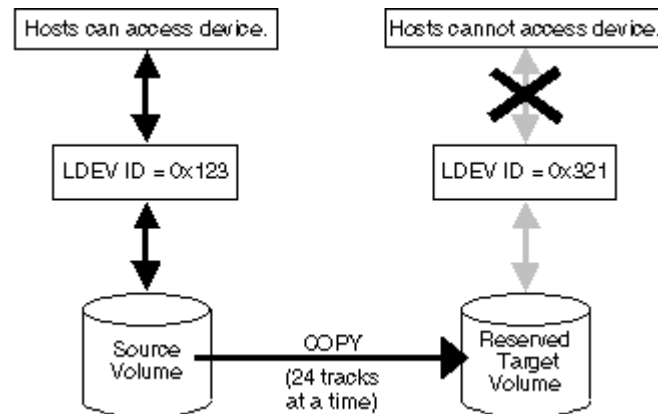
Manual migration consists of the following steps:

1. Collect and analyze the monitored data.
2. Decide on the source and target volumes (make migration plans).
3. Copy the data on the source volume to the target volume. See “Volume migration before move” ([page 21](#)).
4. Transfer host access to the target volume. See “Volume migration after move” ([page 22](#)).

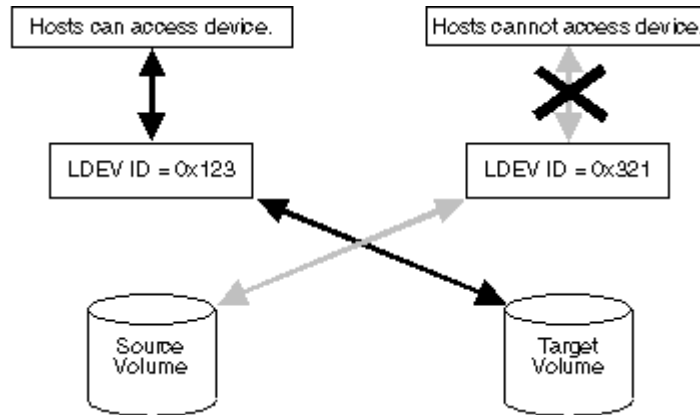
5. Collect more monitoring data to verify the improvements in performance.

The source volume can be online to all hosts during the migration operation. The target volume is reserved prior to migration to prevent host access during migration. The copy operation copies the entire contents of the source volume to the target volume cylinder by cylinder. If the source volume is updated by write I/Os during the copy operation, the disk array keeps track of the updates on a cylinder map of the source volume, and to duplicate the updates at the target volume after the copy operation is complete. (However, if the write I/O pending rate goes above 60%, migration is canceled.) When the volumes are fully synchronized, the disk array completes the migration operation by redirecting host access to the target volume.

Volume migration before move



Volume migration after move



Creating and executing a manual migration plan

To create a manual migration plan:

1. Before starting manual migration, disable automatic migration. Manual migrations should not be done during automatic migrations.
2. Analyze the Auto LUN monitoring data and select the source LDEV:
 - Analyze the DKP, DRR and DKA information to select the DKA pair with utilization much higher than other DKA pairs or DRR/DKP average utilization over 60%.
 - Select the parity group with the highest utilization under the selected DKA pair.
 - Select the LDEV with the highest utilization within the selected parity group.
3. Determine potential target parity groups. These parity groups should satisfy the following conditions:
 - Must not be the same parity group that contains the source LDEV.
 - Must have reserved volumes.
 - The reserved volume should have the same emulation type and size as the source LDEV.

4. Estimate expected utilization for the potential target parity groups.

You can move the source LDEV to any of the potential parity groups. The software predicts the expected usage rate of each parity group after the source LDEV is moved to that parity group.

5. Select the parity group with the lowest expected utilization.
6. Select a target LDEV.

The target LDEV is reserved volume within the selected target parity group receives the migrated data from the source LDEV. You can start migration at this point.

Viewing manual migration status

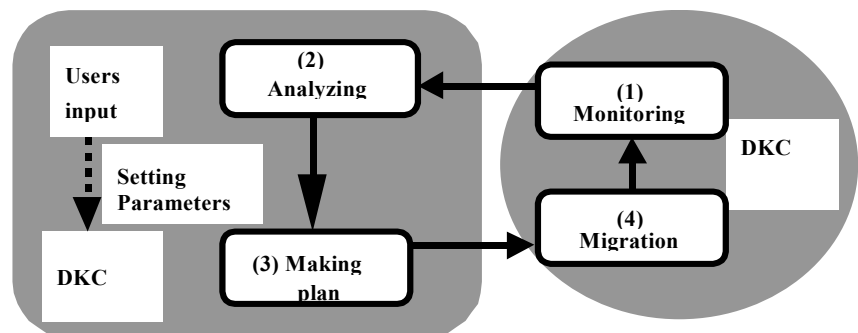
You can have up to 36 simultaneous manual migration plans, although they execute sequentially, one at a time. On the manual migration main window, you can select the desired parity group and target volume, and display the details of that volume's current status.

Cancelling manual migration plans

You can cancel a migration plan when migration is in progress.

Auto migration

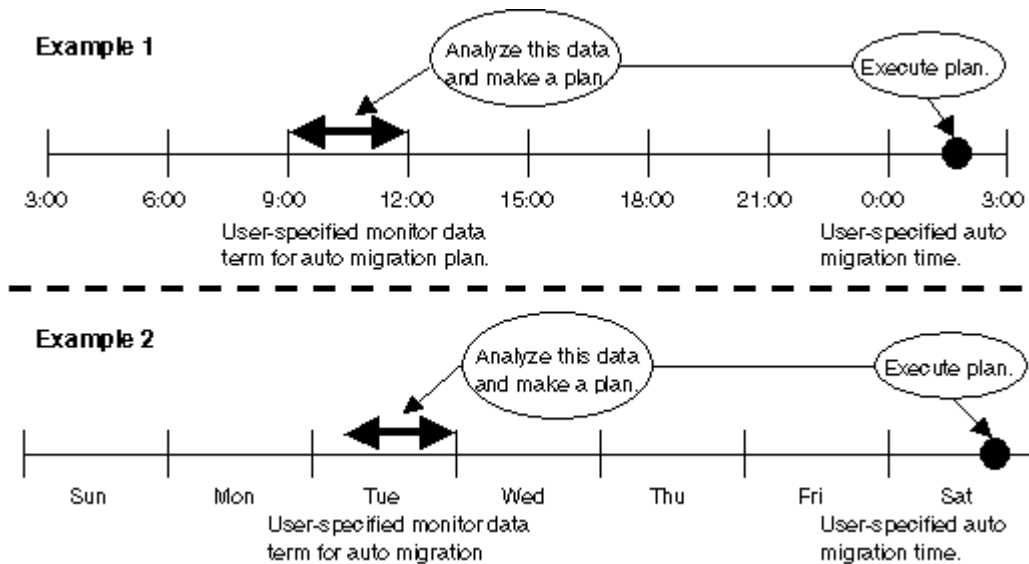
Auto migration provides an automated tuning method for the Disk Array based on parameters you establish.



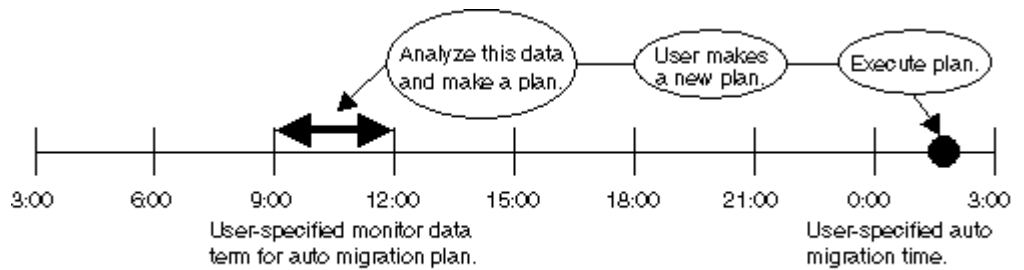
The following steps describe the complete auto migration cycle:

1. Monitoring - The DKC collects utilization information about various components of the disk array and displays it.
2. Analyzing - You enter the various migration parameters which the DKC uses to create the migration plan.
3. Making a plan - The DKC creates a plan based on the monitored data and migration parameter settings.
4. Migration - The DKC performs migration at the time you establish.
5. Repeat monitoring information again to confirm the tuning effects on performance.

The figure below shows two examples of the auto migration process. In the first example, Auto LUN uses the monitoring data collected every day between 09:00 and 12:00 hours to make an auto migration plan, and executes the auto migration plan every day at 02:00 hours.



In the second example, Auto LUN uses the monitoring data collected on Tuesday between 05:30 and 23:30 hours to make an auto migration plan, and executes the plan every day at 18:00 hours.



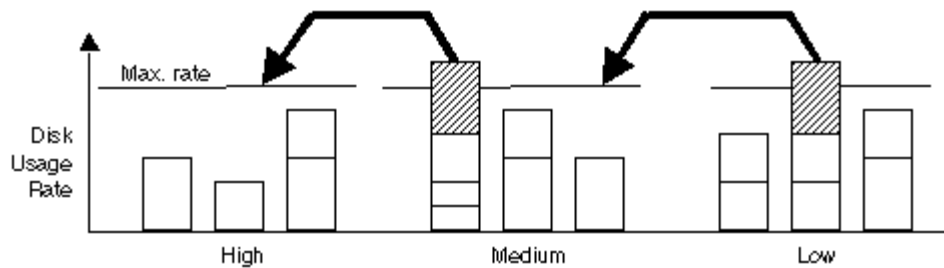
Creating an auto migration plan

You set limits and migration criteria on Auto LUN to create plans that manage volume selection, utilization, and migration.

Setting maximum utilization

Auto migration allows you to set the maximum limit of disk utilization. Disk drives in a disk array can be classified into categories based on their performance speed (low, medium, and high). The Disk Array divides all of its volumes into parity groups with each parity group having only one type and class of disk drive.

You can set the maximum threshold of utilization for each class used in that particular disk array. If the monitored utilization crosses the threshold, Auto migration makes a plan to move the data on the affected volumes to a different parity group in a higher class or to a parity group in the same class but with lower utilization. This alleviates physical disk bottlenecks and provides load balancing.



If a volume is chosen for migration based on its utilization, the disk array checks for reserved volumes similar to the volume being migrated:

- Both volumes must be the same size and emulation type.
- Both volumes must reside in the same DKC.
- The volumes must be of adjacent classes, such as A and B or E and F.

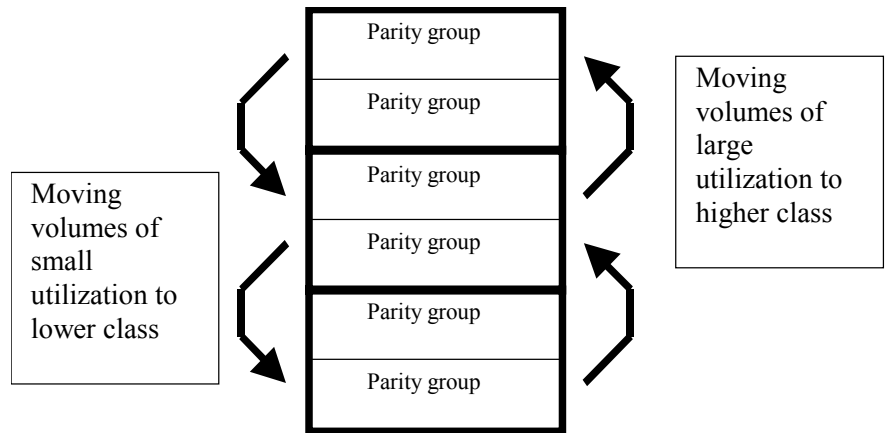
If no reserved volumes meeting these criteria are available, Auto LUN does not make an auto migration plan.

Setting parity groups as “fixed”

To protect critical data, you can exclude certain parity groups from auto migration by setting a parity group as “fixed.” The migration plan ignores fixed parity groups.

Setting reserve volume criteria

Auto migration allows you to select the criteria for choosing reserve volumes: average of disk utilization, average of highest *n*th value of disk utilization in the referred term, and a value considering sequential/random access pattern. You can achieve a significant tuning effect by moving more highly utilized volumes to a higher performance class. When the disk array runs out of reserved (empty) volumes in the higher class, auto migration moves volumes with lower utilization from the higher class to a lower class to make more reserved volumes available in the higher class.



Estimating

The Auto LUN Estimate function allows you to estimate the results of a proposed logical volume migration. You estimate the projected changes in parity group utilization of each logical volume based on the disk array monitoring data. The disk utilization rate of all migrated parity groups cannot exceed the maximum threshold. If the rate of one parity group is over the threshold, Auto LUN will not make a plan.

Setting monitoring time

You can specify the time frame for monitoring volume utilization. This can vary from 1/2 hour to 24 hours at any time in a particular day.

Setting migration time

You can specify the time of day when migration takes place.

Selecting the day for migration

You can set migration to occur daily, or on specific days of the week or month. Actual migration takes place no more than once in a day, however.

Setting limitations

You can specify a limit to prevent overload by the moving (data copy) process. If the disk utilization of parity groups in which moving is started exceeds the moving process limit, migration ends.

You can also specify a time limit for moving. If the plan is not completed within the time limit, the remainder of the plan executes the next day. If a new plan is made before the next migration time, the remaining plans are deleted.

Reference term limitations

Auto LUN may sometimes fail to make a plan because it will not use old information that originated prior to the last volume migration. This reduces the influence of performance factors that may have already been corrected by the last volume migration.

Installation

Remote Control XP (RC) must be installed before installing Auto LUN XP. For information about installing RC, see the *HP StorageWorks Remote Control XP: User's Guide* or contact your HP account representative.

This chapter explains how to install the Auto LUN software. After Auto LUN XP is installed, it is available to administrators and users with appropriate access privileges.

Installing Auto LUN

The installation procedure for Auto LUN is different for the XP256 and the XP512. Refer to the section in this chapter that matches your system:

- “Installing the Auto LUN option license key (XP256)” [\(page 33\)](#)
- “Installing the Auto LUN option software key (XP512/XP48)” [\(page 34\)](#)

Before starting the installation

Before you start the software installation, make sure you have installed the following:

- HP SureStore or StorageWorks Disk Array (XP48, XP256, XP512)
- HP StorageWorks Remote Control XP (RC) software
- Remote console PC with Windows 95, Windows 98, or Windows NT
- Administrator privileges to view and modify access to all remote console functions, including administrator-only functions and restricted functions
- Auto LUN firmware option

Your HP service representative must install the Auto LUN firmware option on the disk array before you install the software license key.

- Auto LUN XP option software license key
- *(Recommended)* HP StorageWorks LUN Manager XP installed on the remote console PC

Auto LUN requirements and restrictions

Logical volumes

- The Auto LUN source and target volumes must be specified by the control unit:logical device (CU:LDEV) number (not volume serial number [VOLSER] or target ID [TID]/logical unit number [LUN]).
- The source and target Auto LUN volumes must reside in the same disk array and must have the same device emulation type and size. Both must be normal or virtual LVI/LUN volumes, not a mix.
- Auto LUN does not support certain logical volumes:
 - Multiplatform volumes (for example, 3390-3A/B/C, 3380-KA/B/C)
 - Volumes that are set as command devices
 - Volumes that are assigned to HP StorageWorks Business Copy XP (BC) and HP StorageWorks Continuous Access XP (CA)

Caution

If you delete a CA pair from the RCU or split a BC pair, Auto LUN displays this simplex volume (SMPL status) as available for migration.

- Volumes that are reserved for BC operations
- Volumes that have Cache LUN data stored in cache
- Volumes that have pinned tracks or that are blocked
- Logical Unit Size Expansion (LUSE) source volumes are specified using one CU:LDEV number. Auto LUN migrates the LDEV, which is part of an LUSE set whose access is higher.

Target volumes

- Target volumes must be reserved prior to migration. Auto LUN allows you to reserve volumes as Auto LUN target volumes.
- Hosts cannot access Auto LUN-reserved volumes.
- LUSE volumes cannot be reserved as target volumes.
- The target volume must be the same size and emulation type as the source volume.

Number of volumes being migrated

- Auto LUN allows you to move up to 40 source volumes at a time.
- The maximum number of Auto LUN volumes plus BC pairs is 512 (64 if the maximum number of BC pairs is 64).

Disk array maintenance

Do not perform Auto LUN operations during disk array maintenance activities (for example, cache or drive installation, replacement, or deinstallation).

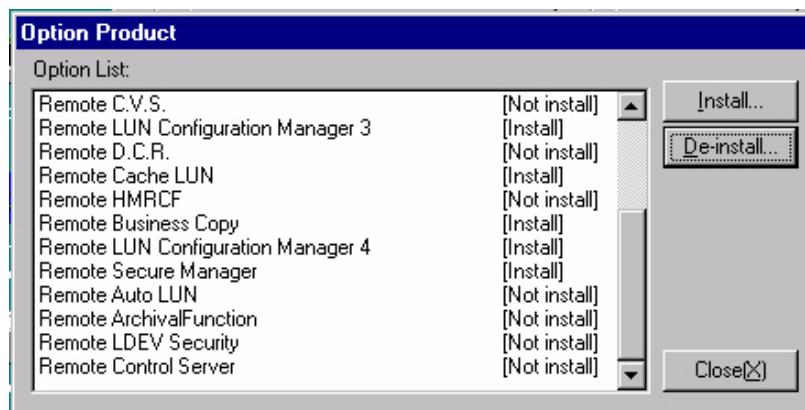
Installing the Auto LUN option license key (XP256)

Before you begin, be sure you have purchased the license key disk for Auto LUN XP.

To install Auto LUN on an XP256 disk array:

1. Log in as an administrator.
2. In the RC main window, click **Option** to open the Option Product window.

This window shows the current installation status of the RC options.



3. Select the **Remote Auto LUN** option from the Option List.
4. Click **Install**.

You are prompted to insert the license key diskette.

5. Insert the key disk into the floppy drive.
6. Click **OK**.

If your key disk is not accepted, verify that the diskette is for Auto LUN. If the disk is correct, contact your HP service representative.

If your key disk is accepted, Auto LUN is now installed.

7. Click **Close**.

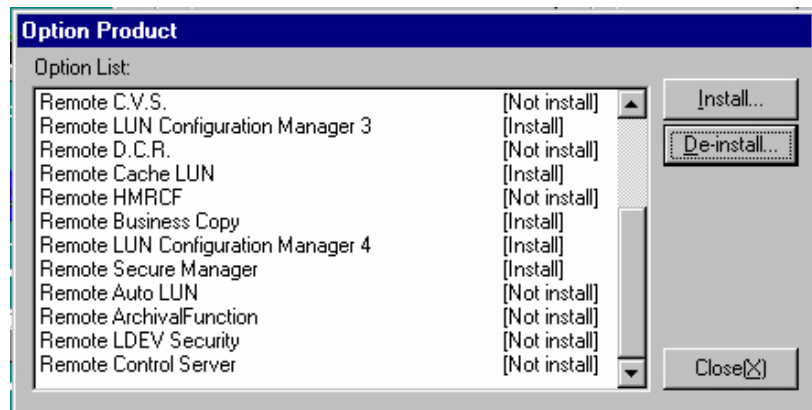
Installing the Auto LUN option software key (XP512/XP48)

Before you begin, be sure you have purchased the license key code for Auto LUN XP.

To install Auto LUN on an XP512/XP48:

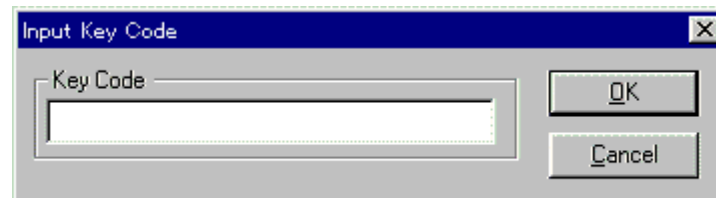
1. Log in as an administrator.
2. In the RC main window, select **Option** to open the Option Product window.

This window shows the current installation status of the RC options.



3. Select the **Remote Auto LUN** option from the Option List.
4. Click **Install**.

The Input Key Code window opens.



5. Enter the license key code in the Key Code text box.

6. Click **OK**.

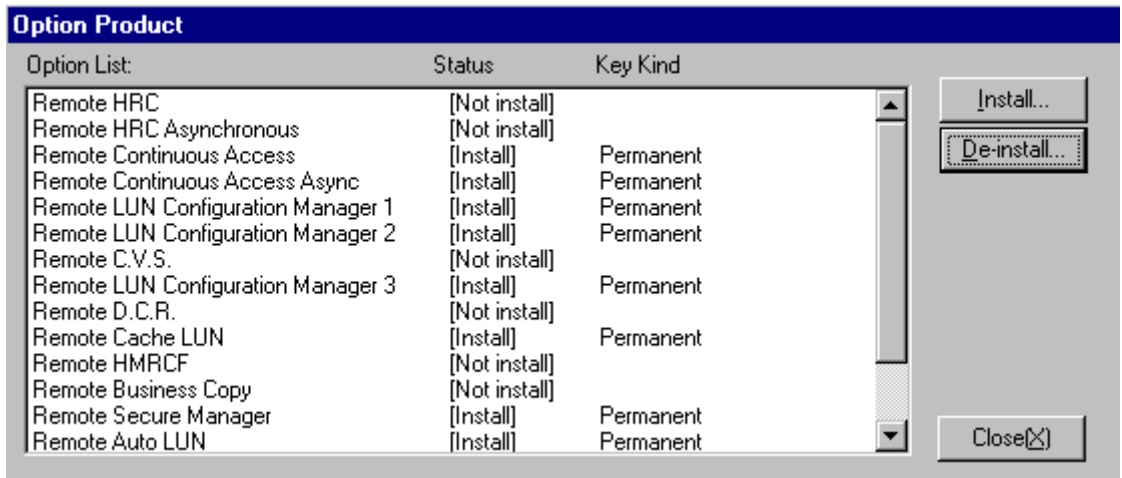
If the password is approved, the Program Product window opens (not shown).

This window shows the product name (Auto LUN), model name, key kind, and effective term.

7. Verify the content of the Program Product window and click **OK**.

When the Auto LUN option installation is complete, the Option Product window opens, and the displayed status of the Auto LUN option changes from Not install to Install.

If your key code is not accepted, verify that the key code is for Auto LUN. If it is correct, contact your HP service representative.



8. Click **Close** to return to the RC main window.

Uninstalling Auto LUN

Uninstalling Auto LUN is the same for both the XP256 and XP512/XP48.

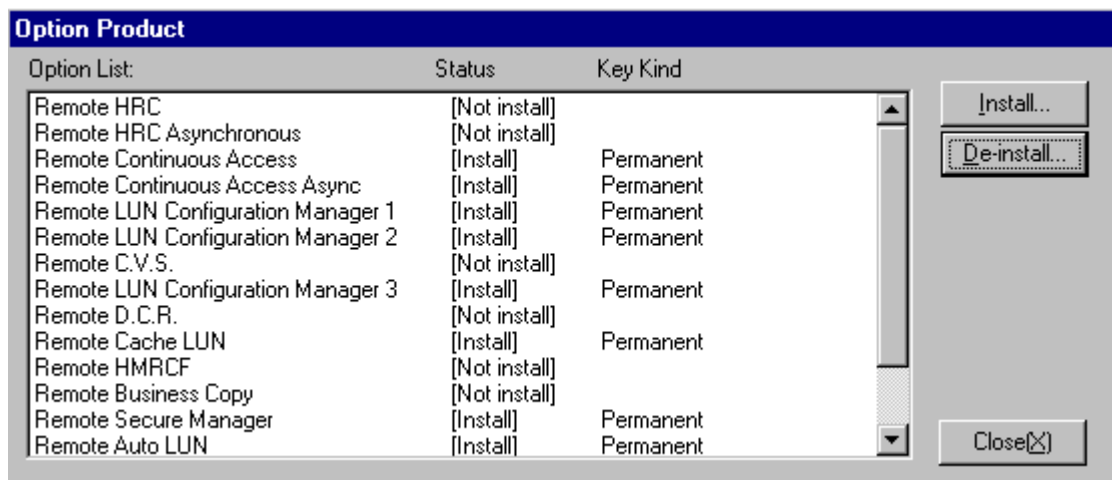
To uninstall Auto LUN:

1. Log in to Remote Control XP as an administrator.

The RC main window opens.

2. Click **Option**.

The Option Product window opens. This window shows the current installation status of the RC options.



3. Select the **Remote Auto LUN** option from the option list.

4. Click **De-install**.

The Auto LUN option is now uninstalled.

5. Click **Close** to return to the RC main window.

Operation

Auto LUN allows you to monitor the disk array usage and performs automatic internal migration of volumes to optimize disk array performance. You can select the time period for disk array monitoring, reserve volumes for Auto LUN manual and automatic migration operations, and specify the criteria for automatic migration. Auto LUN maintains and displays history logs of all Auto LUN operations.

Starting Auto LUN

As soon as Auto LUN software installation is complete, you can start the Auto LUN:

To start Auto LUN:

1. Start and log in to the Remote Control XP (RC) with administrator access or custom Auto LUN access.

If you do not have administrator access or custom Auto LUN access, you can only view the Auto LUN information for the connected subsystem.

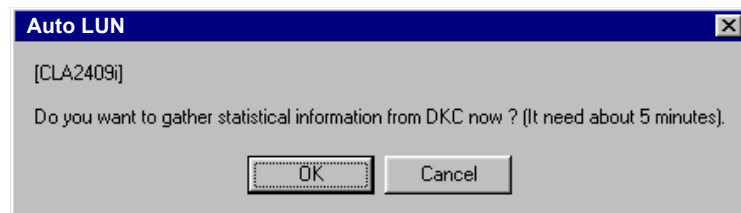
2. Connect to the desired disk array.

Remember that the remote Auto LUN feature must be enabled on each disk array on which you want to perform Auto LUN operations.

When the selected subsystem is connected, the Remote Control Option Select window opens.

3. Click **Auto LUN** to start.

Auto LUN now asks if you want to gather the statistical information (Auto LUN monitoring data) from the DKC (disk controller.)



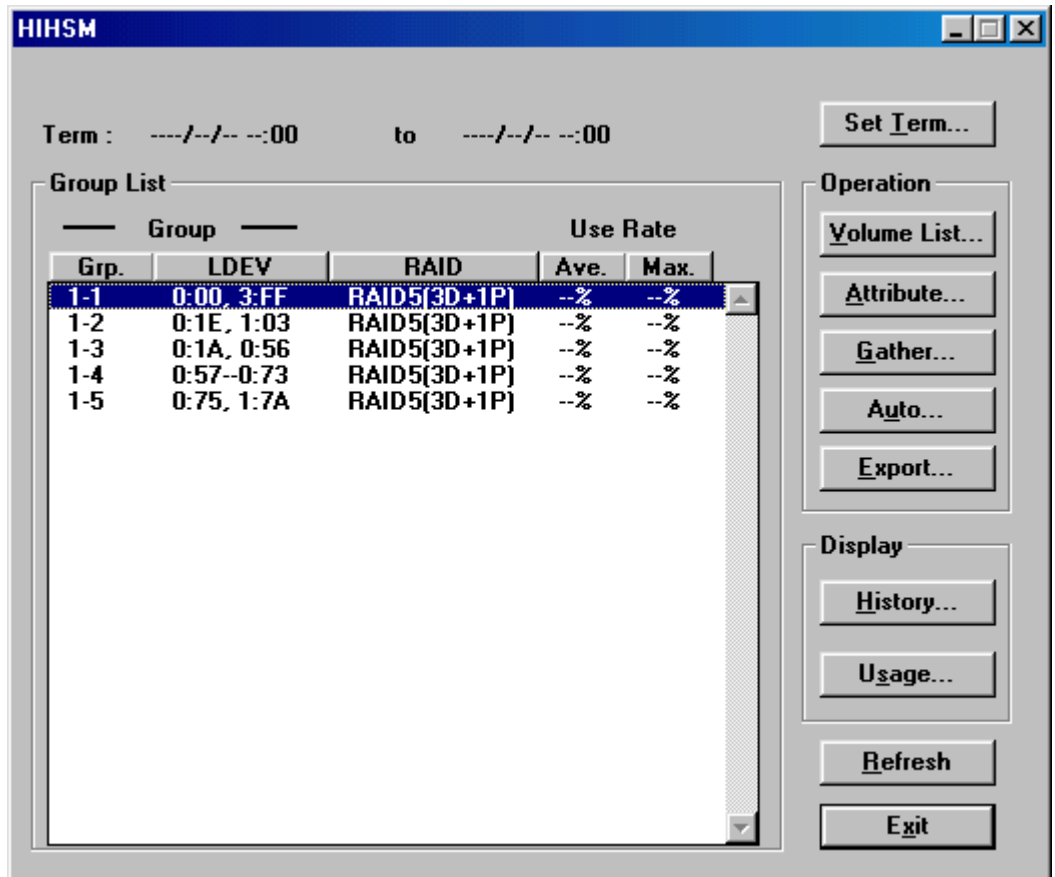
4. If you have not yet started Auto LUN monitoring, click **Cancel**.

The Auto LUN main window opens.

5. If you have already started Auto LUN monitoring, click **OK** to gather the recent monitoring data. Auto LUN loads the monitoring data and then opens the Auto LUN Main window.

Auto LUN Main window

The Auto LUN main window (shown below) displays the parity group information for the connected disk array and provides access to all Auto LUN operations.



The **Term** field shows the term of the monitoring data currently being displayed. Each time you open the main panel, the term set in the previous session is displayed until you refresh the panel.

The **Group List** box displays gathered monitoring data for the connected disk array:

Grp Installed parity groups by location: [frame number] - [parity group number]. See the table below for disk array frame number information. An exclamation mark (!) before a group ID indicates inaccurate usage data because of a configuration change.

Frame Number	ACP Pair	Frame
1	1	Low
2	2	Low
3	3	Low
4	4	Low
5	1	High
6	2	High
7	3	High
8	4	High

LDEV Logical device ID (two-digit hexadecimal value 00–FF).

RAID RAID configuration: RAID5 or RAID0/1.

Use Rate - Ave The average usage rate for the parity group during the monitoring data term.

Use Rate - Max The maximum usage rate for the parity group during the monitoring data term.

Set Term button Opens the Data Term window, which allows you to set the monitoring data term to display on the Auto LUN Main window.

The **Operation** box provides access to Auto LUN functions:

Volume List button Opens the Manual Migration Main window, which allows you to perform manual volume migration.

Attribute button Opens the Change Attribute window, which allows you to change the volume reserve attribute.

Gather button Opens the Data Gathering window, which allows you to set or reset disk array monitoring.

Auto button Opens the Automatic Migration Main window, which allows you to configure and perform automatic volume migration.

Export button Opens the Export Monitor Data window, which allows you to save the monitoring data files.

The **Display** box provides access to the Auto LUN operations:

History button Opens the History window, which displays the Auto LUN history log for *manual* migration operations. (The Auto LUN history log for *auto* migration operations is accessed from the Automatic Migration Main window (**Auto** button).)

Usage button Opens the Usage window, which displays the disk array processor usage rate, bus usage rate, DRR usage rate, access path usage rates, and write-pending rates.

Monitoring operations

Auto LUN monitor operations include

- Starting and stopping monitoring
- Selecting the monitoring data term
- Saving monitoring data to disk

Starting and stopping monitoring

The Data Gathering window allows you to start and stop gathering Auto LUN monitoring data and to select the start time for monitoring, end time for monitoring, and duration of the monitoring interval.

To open the Data Gathering window, click **Gather** on the Auto LUN Main window.

The Time box allows you to select the time (00:00–11:00 except 01:00, 02:00, and 03:00) to start collecting monitoring data. For example, if you turn monitoring ON and enter 04:00, the SVP will collect and store Auto LUN monitoring data from the disk array every twelve hours starting at 4 a.m. (04:00 hours) and 4 p.m. (16:00 hours). Set the time except 01:00, 02:00, and 03:00. The end of the data displayed is one hour earlier than the time you set.

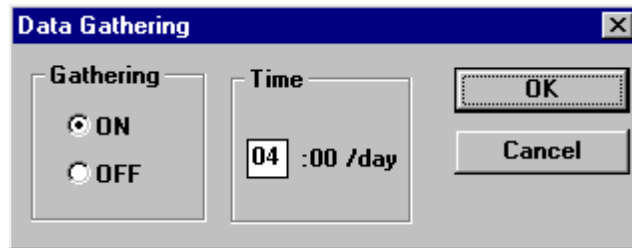
The SVP stores 24 hours of monitoring data as a backup in case the disk array is not available for a scheduled monitoring. Old monitoring data is overwritten when new data is gathered.

Caution

Schedule your Auto LUN monitoring at a different time than the 8800 SVP auto-reboot time. When the SVP reboots, Auto LUN monitoring is discontinued and will not resume until the next scheduled start time.

To start Auto LUN monitoring of the connected disk array:

1. On the Auto LUN Main window, click **Gather** to open the Data Gathering window.



2. On the Data Gathering window, verify/enter the desired data gathering schedule.
3. Click **ON** to turn Auto LUN monitoring on, and then click **OK** to start the specified data gathering schedule.

To stop Auto LUN monitoring of the connected disk array:

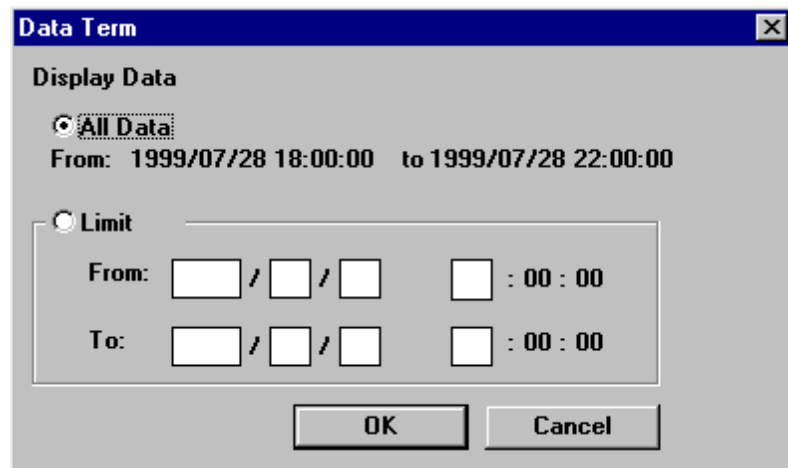
1. In the Auto LUN Main window, click **Gather** to open the Data Gathering window.
2. Click **OFF** to turn Auto LUN monitoring off, and then click **OK**.

When you turn monitoring OFF, the disk array monitoring data that has not yet been loaded by the Auto LUN software is discarded. If you need this data, exit and restart Auto LUN to load the monitoring data.

Selecting the monitoring data term

The Data Term window allows you to select the range of disk array monitoring data to be displayed on the Auto LUN Main window. You can display all monitoring data that was gathered when the Auto LUN software was launched, or you can display a specific range of monitoring data. For manual migration, Auto LUN uses the data in the specified monitoring data term to calculate estimated usage rates.

1. On the Auto LUN Main window, click the **Set Term** button to open the Data Term window.



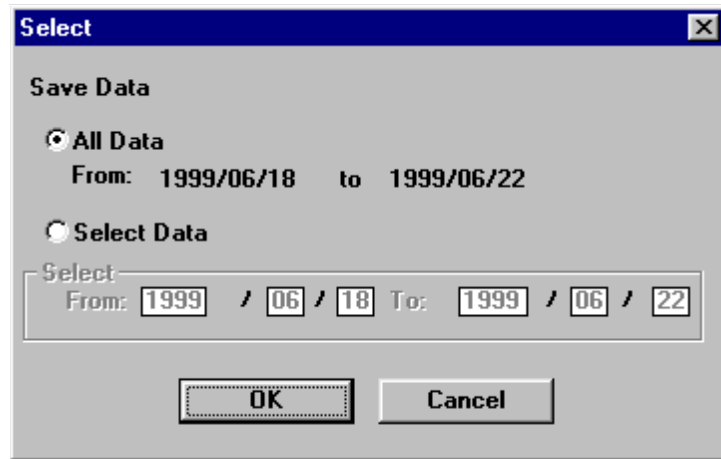
2. On the Data Term Window, click **All Data** to display all monitoring data, or click **Limit** and enter the starting date/time (**From**) and ending date/time (**To**) for the desired range of monitoring data. A minimum range of one hour is required to view usage data. Enter dates in *yyyy/mm/dd/hh* format.
3. Click **OK** to display the selected monitoring data term (all or specified range).

Saving monitoring data to disk

The Export Monitor Data window allows you to save Auto LUN monitoring data on disk.

1. In the Auto LUN Main window, click the **Export** button.

The Export Monitor Data window opens.

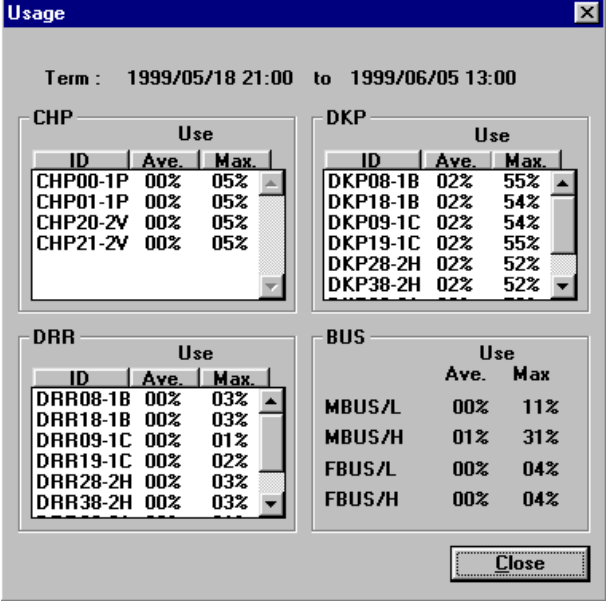


2. In the Export Monitor Data window, click **All Data** to save all monitoring data (gathered when the Auto LUN software was launched), or click **Select Data** and enter the desired range to save a specific range of monitoring data.
3. Click **OK** to save the selected monitoring data to the floppy diskette drive (A:).
4. Remove the floppy diskette when finished.

Auto LUN allows you to graph the exported monitoring data in Microsoft Excel or using the supplied GraphTool software. For more information about graphing in Excel, see “Making a graph of Auto LUN monitoring data” ([page 76](#)). For details about using GraphTool, see [Chapter 4](#).

Viewing the volume usage rate

The Usage window displays the detailed disk array usage statistics for the specified monitoring data term. To open the Usage window, click **Usage** on the Auto LUN main window.



Term : 1999/05/18 21:00 to 1999/06/05 13:00

CHP		
ID	Ave.	Max.
CHP00-1P	00%	05%
CHP01-1P	00%	05%
CHP20-2V	00%	05%
CHP21-2V	00%	05%

DKP		
ID	Ave.	Max.
DKP08-1B	02%	55%
DKP18-1B	02%	54%
DKP09-1C	02%	54%
DKP19-1C	02%	55%
DKP28-2H	02%	52%
DKP38-2H	02%	52%

DRR		
ID	Ave.	Max.
DRR08-1B	00%	03%
DRR18-1B	00%	03%
DRR09-1C	00%	01%
DRR19-1C	00%	02%
DRR28-2H	00%	03%
DRR38-2H	00%	03%

BUS		
	Ave.	Max.
MBUS/L	00%	11%
MBUS/H	01%	31%
FBUS/L	00%	04%
FBUS/H	00%	04%

Close

The Usage window displays the following information for the selected parity group:

- CHP** Average and maximum usage of the CHIPs for the specified monitoring data term.
- DKP** Average and maximum usage of the ACPs for the specified monitoring data term.
- DRR** Average and maximum usage of the DRRs for the specified monitoring data term.
- BUS** Average and maximum usage of the M-bus-low, M-bus-high, F-bus-low, F-bus-high for the specified monitoring data term.

Reserving volumes

The Normal and Reserved volume attributes indicate which volumes are available for use as Auto LUN target volumes. Auto LUN target volumes must be reserved. A normal volume cannot be used as a target volume. Before Auto LUN migration is performed, decide which volumes will become the Auto LUN target volumes and change their volume attribute to Reserved.

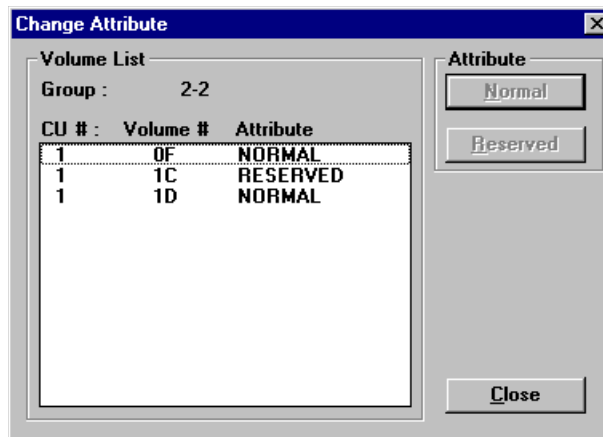
The Change Attribute window displays and allows you to change the Normal/ Reserved attribute of the LDEVs in the selected parity group.

To open the Change Attribute window, select a parity group on the Auto LUN Main window, and then click the Attribute button.

Caution *If a LUN is going to be used as a target volume for Auto LUN and have its volume attribute set to Reserved, that volume must not have a path currently assigned to it. Before changing the attribute of a volume, make sure that the volume does not have a path assigned to it from the LUN Management screen.*

To reserve or unreserve a volume:

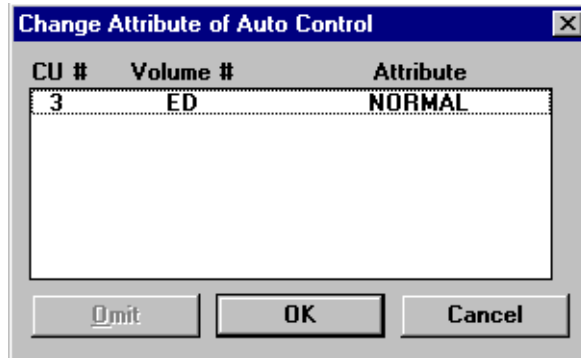
1. Select a parity group on the Auto LUN Main window and then click **Attribute**. The Change Attribute window opens.



2. Select the desired volumes and then click **Normal** or **Reserved**.

Only one of these buttons is enabled, based on the selected volumes.

The Change Attribute of Auto Control window displays your requested change.



3. To delete a volume from the list, select it and then click **Omit**.

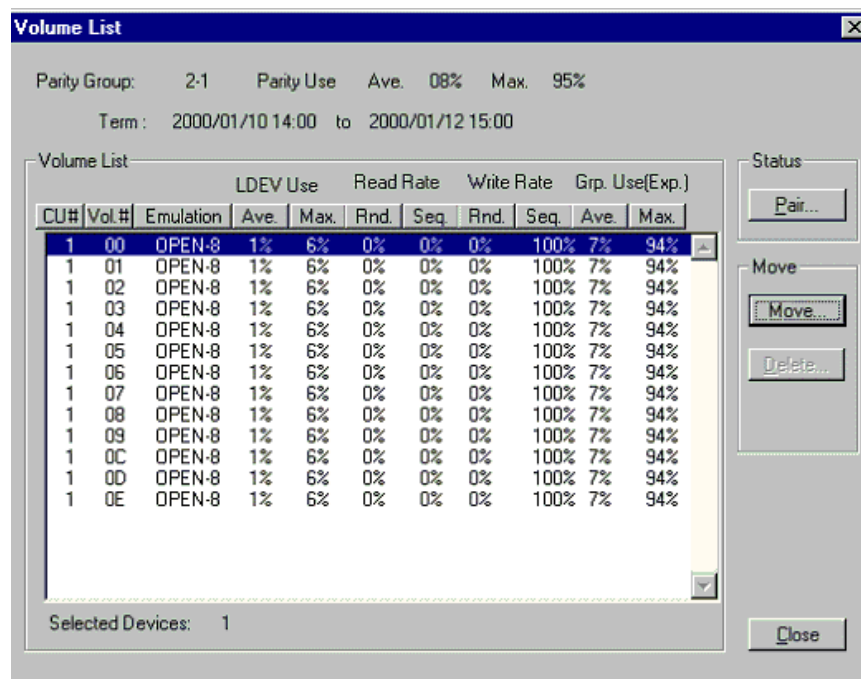
To cancel your request, click **Cancel**.

To make the requested attribute changes, click **OK**.

Performing manual migration

The Volume List window displays the Auto LUN information for the selected parity group and allows you to start manual migration operations, view manual migration status, and stop manual migration operations that are in progress.

To open the Volume List window, select the desired parity group on the Auto LUN Main window and then click **Volume List**.



The Volume List window displays the following information:

- Parity Group** Number of the parity group.
- Parity Use** Usage rate of the parity group.
- Ave.** Average rate of the usage in the parity group.

Max.	Maximum rate of the usage in the parity group.
Term	monitoring data term that is being displayed.
CU#	CU number.
Vol.#	LDEV ID.
Emulation	Device emulation type.
LDEV Use	Usage rate of the volume. Ave.: Average volume usage rate. Max.: Maximum volume usage rate.
Read Rate	Read I/O rate. Rnd.: Read I/O rate for random access mode. Seq.: Read I/O rate for sequential access mode.
Write Rate	Write I/O rate. Rnd.: Write I/O rate for random access mode. Seq.: Write I/O rate for sequential access mode.
Grp.Use (Exp.)	Usage rate of parity group in the case that the volume is not installed. Ave.: Average volume usage rate. Max.: Maximum volume usage rate.
Status-Pair button	Opens the Pair Status window, which displays the ID, reserve attribute, and device emulation of the selected volume and the other volume in the Auto LUN pair and the status of the Auto LUN migration operation.
Move button	Opens the Move Volume window, which allows you to start a manual migration operation on the selected volume.
Delete button	Opens the Delete Pair Confirmation window, which allows you to stop manual migration operations that are in progress.

Starting manual migration

To open the Move Volume window, select the volume to be migrated on the Volume List window and then click the Move button.

The Move Volume window displays the selected manual migration source volume and the available target parity groups (that is, parity groups with reserved volumes) and allows you to select the target parity group for manual migration.

The **Source Volume** box displays the following information for the selected volume: parity group ID, CU number, LDEV ID, emulation type, and estimated parity group usage after the proposed migration.

The **Group List** box displays the available target parity groups and their current usage rates (Use Rate) and estimated (expected) usage rates (Grp. Use (Exp.)). Auto LUN uses the currently specified monitoring data term to calculate estimated usage.

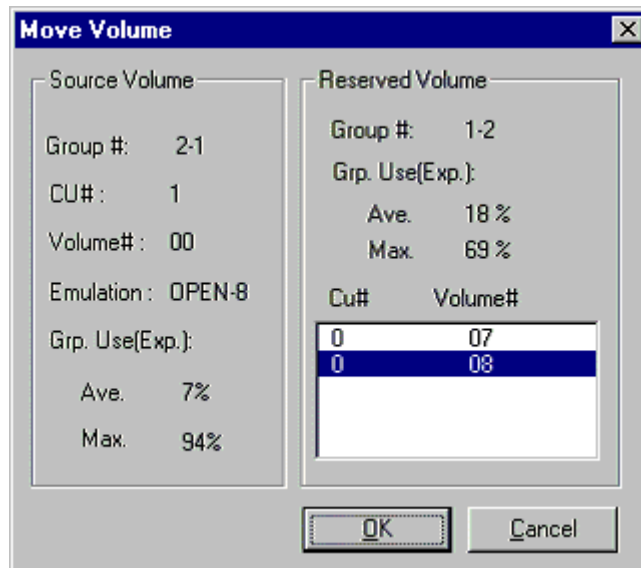
To start a manual migration operation:

1. On the Auto LUN Main window, select the parity group that contains the volume that you want to migrate and then click **Volume List**.

The Volume List window opens.

2. Select the desired volume and then click **Move**.

The Move Volume window opens.



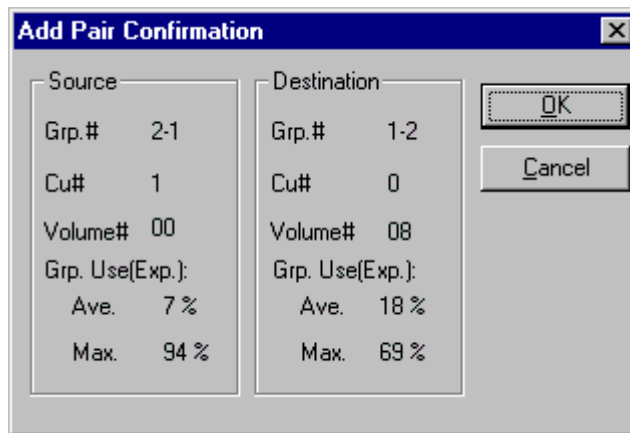
The Move Volume window displays the actual volume usage rate of each target parity group and the estimated volume usage rate after migration.

3. After reviewing the estimated usage rate information, select the desired target parity group and then click **OK**.

The Select Target Volume window now opens and displays the available target volumes (that is, reserved volumes) in the selected parity group.

4. Select the desired target volume and click **OK**.

The Add Pair Confirmation window displays the selected source and target volumes and the expected usage rates after migration.



The dialog box titled "Add Pair Confirmation" contains two columns of data. The left column, labeled "Source", lists: Grp.# 2-1, Cu# 1, Volume# 00, Grp. Use(Exp.): Ave. 7 %, and Max. 94 %. The right column, labeled "Destination", lists: Grp.# 1-2, Cu# 0, Volume# 08, Grp. Use(Exp.): Ave. 18 %, and Max. 69 %. To the right of these columns are two buttons: "OK" and "Cancel".

Source		Destination	
Grp.#	2-1	Grp.#	1-2
Cu#	1	Cu#	0
Volume#	00	Volume#	08
Grp. Use(Exp.):		Grp. Use(Exp.):	
Ave.	7 %	Ave.	18 %
Max.	94 %	Max.	69 %

5. After reviewing this information, click **OK** to start the specified migration or click **Cancel** to cancel your request.

Checking manual migration status for source and target volumes

The Pair Status window displays the properties (parity group, LDEV ID, reserve attribute, device emulation) of the selected volume and the other volume in the Auto LUN pair, as well as the status of the Auto LUN migration operation.

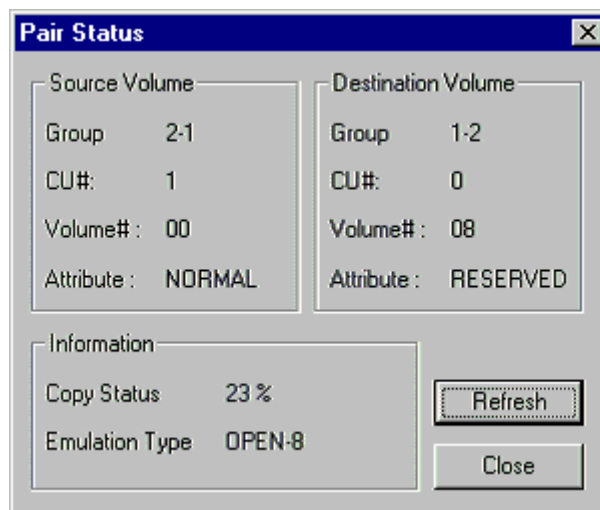
To open the Pair Status window, select the desired volume on the Volume List window and then click the Status-Pair button.

To check manual migration status:

1. On the Auto LUN Main window, select the parity group that contains the desired volume and then click **Volume List**.

The Volume List window opens.

2. Select the desired volume on the Volume List window and click **Status-Pair**.



The **Refresh** button updates the copy status information displayed on the window.

Stopping manual migration

You can delete an Auto LUN pair any time before the manual migration completes. When an Auto LUN pair is deleted, the data on the target volume is not guaranteed.

The Delete Pair Confirmation window displays the requested Auto LUN pair delete operation and allows you to delete the specified manual migration pairs.

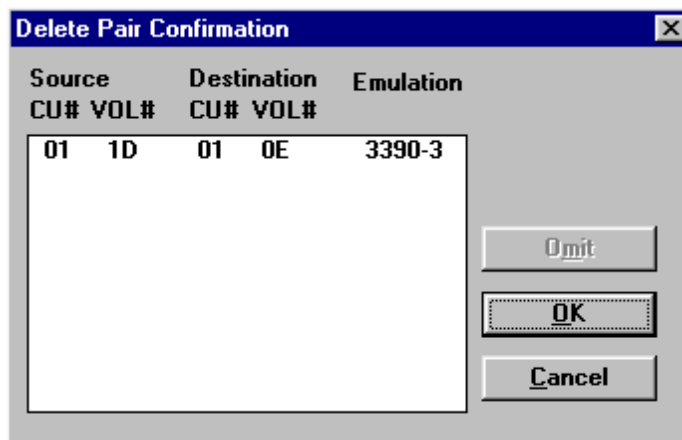
To stop one or more manual migration operations:

1. On the Auto LUN Main window, select the parity group that contains the desired volumes and then click **Volume List**.

The Volume List window opens. The Volume List window displays an asterisk (*) by volumes that are currently being migrated.

2. Select the desired volumes and then click **Delete**.

The Delete Pair Confirmation window opens to display the selected volume pairs.



3. To remove an Auto LUN volume pair from the list, select it and then click **Omit**.

To cancel your request to end the migration, click **Cancel**.

To stop the migration, click **OK**.

Performing automatic migration

With automatic migration, Auto LUN automatically selects the volumes to migrate by using the maximum disk utilization value.

The program automatically classifies disks according to each disk type. The program assigns the highest performance disk type as Class A and the lower performance type as Class B, C, D, E, and F. The program assigns a maximum of six classes according to the disk types. These classes depend on the installed disk types. The tables below show examples of these classifications.

For the latest information on available hard disk drive types, contact your HP representative.

Disk type performance

Order	Disk Type	
0	DK3F2	high performance
1	DK3F1	
2	DK30A	
3	DK309	t
4	DK308	
5	DK306	
		low performance

Examples of class assignments for installed disk types

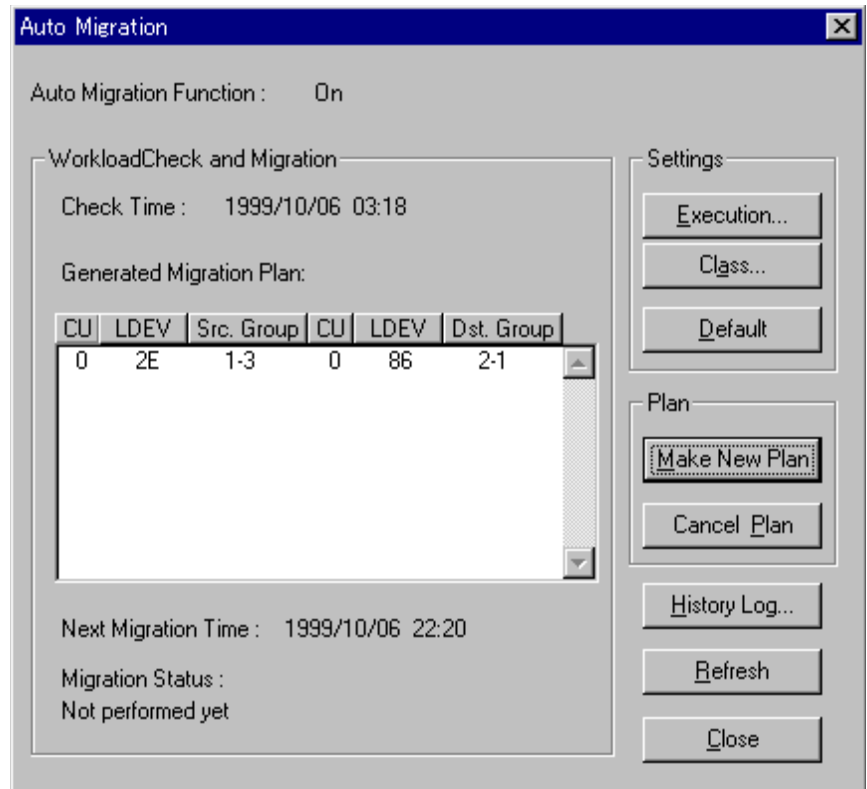
Example 1

Installed Disk	Order	Assigned Class
DK3F2	0	Class A
DK30A	2	Class B
DK308	4	Class C

Example 2

Installed Disk	Order	Assigned Class
DK309	3	Class A
DK308	4	Class B

To open the Auto Migration window, select **Auto** from the Auto LUN main window.



Auto Migration Function

This flag indicates whether the auto migration function is available (ON) or not available (OFF). You set this flag in the Execution Parameter Setting window (**Execution** button on the Auto LUN main window).

Workload Check and Migration

This box displays the setting status of automatic migration.

Check Time

The next check time to determine the volume migration plan. This time is recorded by DKC (disk controller) so that it does not correspond to the remote console PC time.

Generated Migration Plan

The General Migration Plan shows:

CU: CU number of the source volume.
LDEV: Logical volume number of the source volume.
CU: CU number of the target volume.
LDEV: Logical volume number of the target volume.
Src. Group: Parity Group number to which the source volume belongs.
Dst. Group: Parity Group number to which the target volume belongs.

Next Migration Time

The time to execute volume migration. DKC (disk controller) records this time, so it does not correspond to the remote console time.

Migration Status The migration plan has different status levels:

Not planned yet: No plan was made.
Not performed yet: Plan has been made but has not been executed.
Failed to make plan: Could not make a plan.
Under migration: Auto LUN is migrating the volume
Last migration has canceled (Please see log file):
Auto LUN canceled the migration plan.
Migration successfully ended:
Plan has done: Plan has been executed.

Execution button Sets the detail parameters for volume migration. After selecting this button, the program displays Automatic Migration Setting window.

Class button Displays the class attribution in each parity group. There are three classes, according to the installed drive type. After selecting this button, the program displays the Class List window.

Default button Resets the detail parameters for volume migration as default value.

Make New Plan button
Makes a new migration plan. After selecting this button, the program makes a new migration plan and displays the plan in the Generated Migration Plan box. (The program deletes the remaining plans.)

Caution *Do not click the Make New Plan button when the migration status is Under migration.*

Cancel Plan button
Deletes the migration plans in the Generated Migration Plan. The generated migration plan executes at the Settings time. Although you delete the plan by selecting **Cancel plan** during the planned migration, the program does not cancel a currently executing migration. If you want to cancel those migrations, you must cancel the volume migration one by one manually.

History Log button
Displays the Automatic migration history window.

Refresh button Refreshes the status to read configuration information.

Close button Exits this window. After selecting it, the program displays the main window.

Setting or resetting fixed parity groups

A fixed parity group is a parity group that cannot be selected for automatic volume migration. If you want to exclude an entire parity group from automatic migration, you must set the parity group as fixed before configuring automatic migration operations.

The Class List window lists the classes of installed disk drives and displays the number of parity groups, number of volumes, and number of reserved volumes for each class.

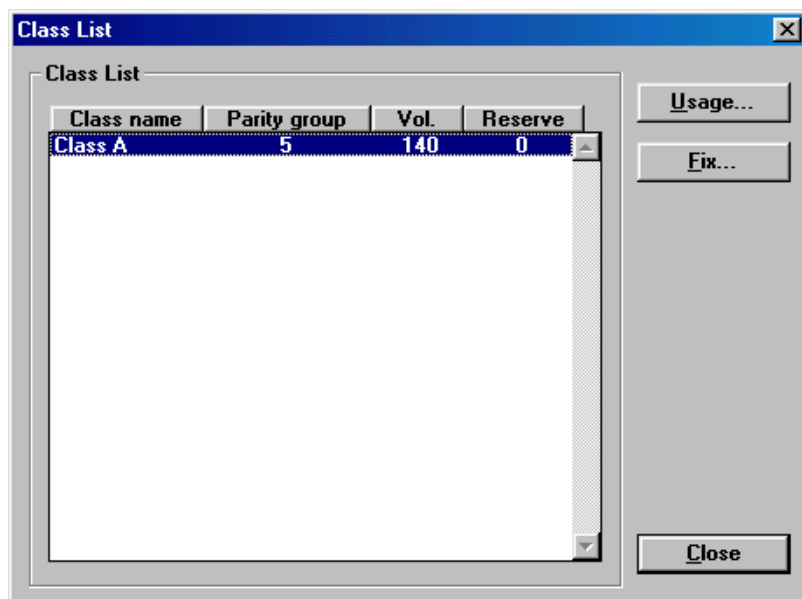
To set or reset a fixed parity group:

1. On the Auto LUN Main window, click **Auto**.

The Auto Migration window opens.

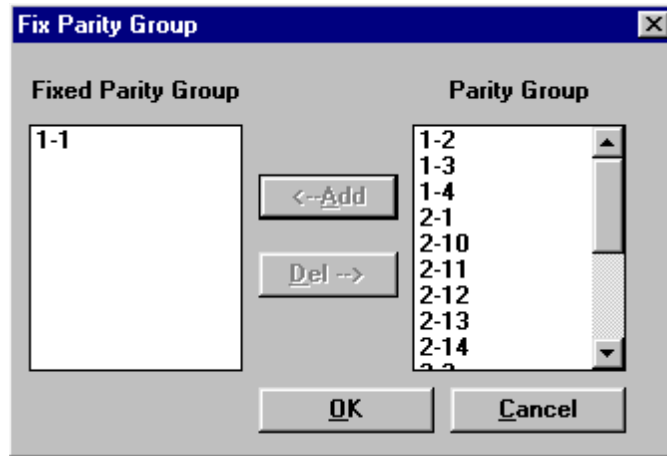
2. Click **Class**.

The Class List window opens.



3. After reviewing the information displayed on the Class List window, click **Fix**.

The Fix Parity Group window opens to display a list of fixed parity groups and a list of normal (not fixed) parity groups. You can add groups and delete groups from each list.



4. To add a parity group to the list of fixed parity groups, select the parity group in the Parity Group list and then click **Add**.

To remove a parity group from the list of fixed parity groups, select the parity group in the Fixed Parity Group list and then click **Del**.

5. When you complete your entries in the Fixed Parity Group list, click **OK**.

The parity groups in the Fixed Parity Group list are set as fixed parity groups, and the parity groups in the Parity Group list are set as normal (not fixed) parity groups.

Setting the maximum disk usage

The Class Usage window displays the parity groups in the selected class and allows you to set the maximum disk utilization for the class.

When you use the same maximum disk usage rate for all HDD classes, the performance of the HDD becomes the only factor used in determining auto

migration plans. When you specify different usage limits for the HDD classes, you can bias the auto migration function to favor (or avoid) certain HDD types. The migration of high-usage volumes to higher HDD classes is expected to significantly improve host access to the volumes, which in itself can also have a large effect on subsystem performance. You should always carefully analyze monitoring data collected after migration to verify the results of migration operations. The results of auto migration operations can help you to determine the appropriate disk usage limits for your configuration and operational environment.

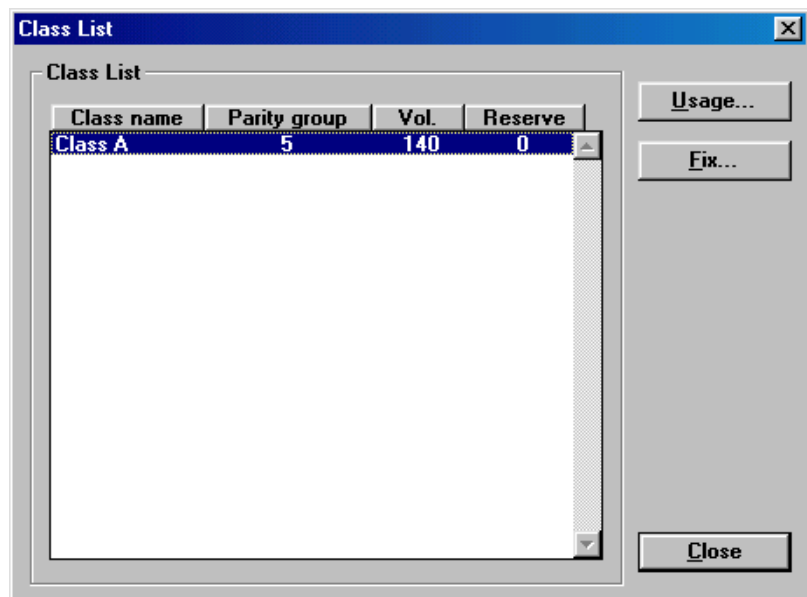
To set the maximum disk usage:

1. On the Auto LUN Main window, click **Auto**.

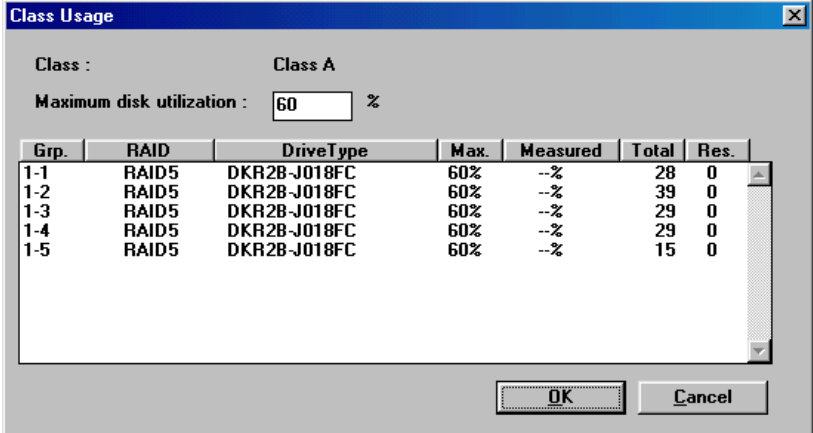
The Auto Migration window opens.

2. Click **Class**.

The Class List window opens.



3. Select the desired class (for example, Class A) and then click **Usage**.
The Class Usage window opens.



The Class Usage dialog box is titled "Class Usage". It contains a "Class :" label with "Class A" selected. Below it is a "Maximum disk utilization :" label with a text box containing "60" and a "%" symbol. A table with 7 columns (Grp., RAID, DriveType, Max., Measured, Total, Res.) displays data for RAID groups 1-1 through 1-5. At the bottom are "OK" and "Cancel" buttons.

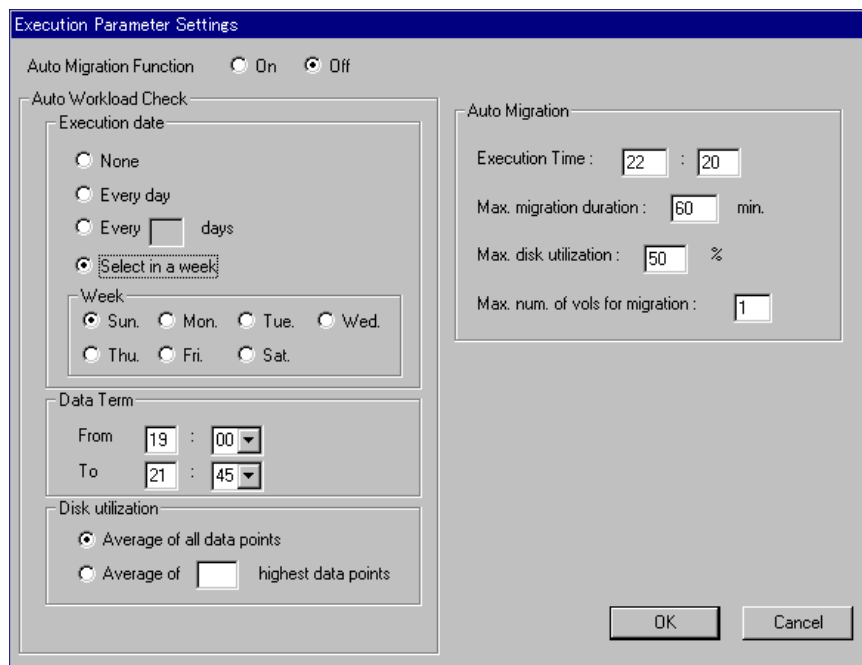
Grp.	RAID	DriveType	Max.	Measured	Total	Res.
1-1	RAID5	DKR2B-J018FC	60%	--%	28	0
1-2	RAID5	DKR2B-J018FC	60%	--%	39	0
1-3	RAID5	DKR2B-J018FC	60%	--%	29	0
1-4	RAID5	DKR2B-J018FC	60%	--%	29	0
1-5	RAID5	DKR2B-J018FC	60%	--%	15	0

4. Enter the desired value in the Maximum disk utilization field and then click **OK**.

The default maximum usage values are rough estimates only and may not provide the best results. Specify the appropriate values for your operational environment.

Setting the evaluating schedule and migration time

The Execution Parameter Settings window allows you to configure the auto migration settings and turn auto migration ON and OFF.



The image shows a Windows-style dialog box titled "Execution Parameter Settings". It has a blue title bar and a grey body. At the top, there are two radio buttons for "Auto Migration Function": "On" and "Off", with "Off" being selected. Below this is a section titled "Auto Workload Check" which contains three sub-sections: "Execution date", "Data Term", and "Disk utilization". The "Execution date" section has four radio buttons: "None", "Every day", "Every [] days", and "Select in a week" (which is selected). Below "Select in a week" is a "Week" section with seven radio buttons for the days of the week: "Sun.", "Mon.", "Tue.", "Wed.", "Thu.", "Fri.", and "Sat.". The "Data Term" section has two rows of time pickers: "From" (19 : 00) and "To" (21 : 45). The "Disk utilization" section has two radio buttons: "Average of all data points" (selected) and "Average of [] highest data points". To the right of the "Auto Workload Check" section is a section titled "Auto Migration" which contains four rows of input fields: "Execution Time" (22 : 20), "Max. migration duration" (60 min.), "Max. disk utilization" (50 %), and "Max. num. of vols for migration" (1). At the bottom right of the dialog are "OK" and "Cancel" buttons.

The **Auto Migration Function** buttons allow you to turn auto migration ON and OFF.

The **Auto Workload Check** box allows you to set the monitoring term and disk utilization calculation for automatic migration. The monitoring data is gathered and stored whether or not automatic migration is performed.

The **Execution Date**, **Data Term**, and **Disk Utilization** boxes within the Auto Workload Check box allow you to set the monitoring term and the disk utilization parameters:

Execution Date

None	Do not make an auto migration plan. If an old plan remains, the program executes auto migration using this plan.
Every day	Execute auto migration every day.
Every x days	Execute auto migration every x ($x = 2-31$) days.
Select in a week	Execute auto migration on the selected day.
Every x in a Month (XP512)	Execute auto migration every x day in a month.

Data Term

From	Start time of monitoring data term: 00–23 hours with 15-minute increments.
To	End time of monitoring data term: 00–23 hours with 15-minute increments.

Caution	<i>Automatic reboot or automatic data gathering must not be set from the end of the target term to an hour.</i>
----------------	---

Disk Utilization

Average of all data points

Determine disk utilization using the average usage rate for all monitoring data samples.

Average of x highest data points

Determine disk utilization using the average usage rate for the highest monitoring data samples.

Auto Migration

Execution Time Start time of auto migration. Choose an auto migration time at least an hour after data gathering to allow time for

planning prior to migration. Also select a time that will not conflict with the SVP auto-reboot time.

Max. migration duration

Migration duration limit (10–120 minutes). If auto migration does not finish within this time, the migration is stopped.

Max. disk utilization

Maximum disk usage rate (10–100%). If disk usage is over this limit during migration, the migration is stopped. Input the maximum available rate (%). For example, if you input 60 and the disk utilization is higher than 60, the migration stops.

Max. num of vols for migration

Maximum number of migration volumes (1–20) during the same migration term.

Caution

Automatic reboot or automatic data gathering must not be set in the following duration:

- 15 minutes before starting making the plan (15 + migration time);
 - 30 minutes after starting making the plan.
 - Time when the plan is made is not within the duration from 15 minutes before the target term (15 + migration time) to one hour after the term.
-

To set the evaluating schedule and auto migration time:

1. Click **Auto** on the Auto LUN Main window.
The Auto Migration window opens.
2. Click the **Execution** button.
The Execution Parameter Settings window ([page 64](#)) opens.
3. Click the Auto Migration Function **ON** radio button.
4. In the **Execution Date** box, click the appropriate radio button to set the migration frequency:
5. Set the **Data Term** by inputting the start and end times for data monitoring.

6. Set the Disk Utilization by selecting one of the following two kinds of determination points:

Average of all data points

Average of x highest data points

7. Set the Auto Migration input on the migration schedule.

Execution Time

Max. migration duration

Max. disk utilization

Max. num of vols for migration

8. Confirm the parameter you entered and click **OK**.

If the disk array internal service processor (SVP) reboots during auto migration, Auto LUN displays as SVP Reboot in the History window but does not record the migration result. See the main history.

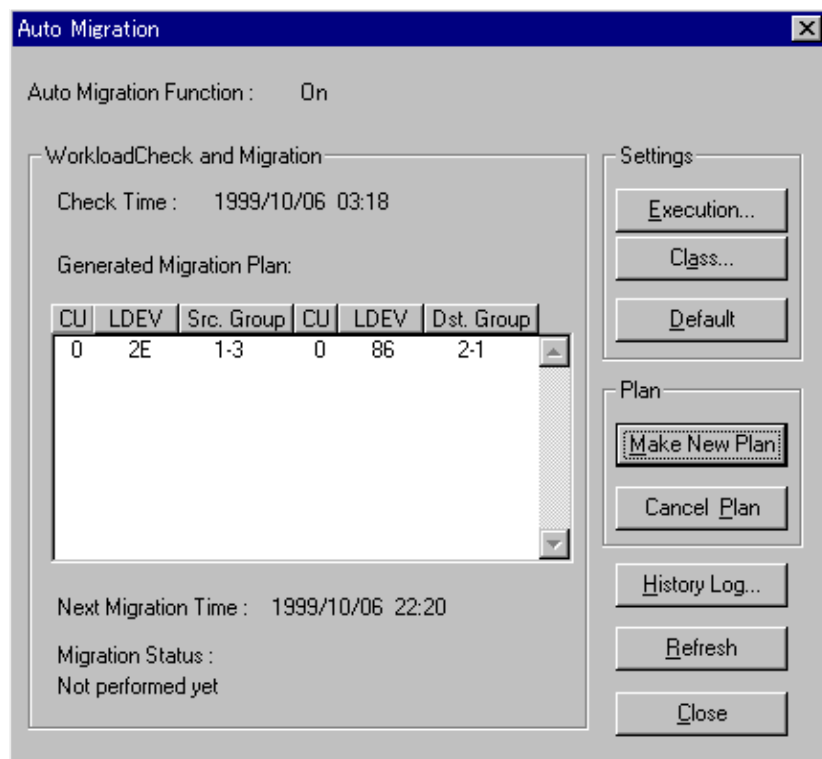
9. If old plans in the Auto plan remain (before SVP rebooting), and Auto LUN displays as Under Migration in the Status, cancel those volumes under migration.

Making a new automatic migration plan

After monitoring the disk usage according to the evaluating schedule, the migration plan can be made. Auto LUN usually makes these plans automatically. However, you can make a plan by performing the following operations.

Auto migration is usually planned for migrating multiple LDEVs in a consecutive sequence, and one LDEV after another should be migrated according to the sequence of those consecutive plans. When you make several auto migration plans, the sequence of migration may be important, and the plans are likely to affect one another. Therefore, you are not allowed to delete one of the consecutive plans. If you delete a plan, the remaining plans specified to be executed after the deleted plan will also be deleted.

1. Click the Auto button in the main window.
2. The Automatic Migration Main window opens.



3. Click the **Make New Plan** button.

The program displays new plans in the Generated Migration Plan. The program executes the volume migration according to the generated migration plans at the times that are displayed in the Next Migration Time. Auto LUN sometimes does not make a plan as the result of Make New Plan. See the History Log ([page 70](#)).

4. Check the generated plan.

If you do not agree with this plan, click **Cancel Plan**. Auto LUN deletes plans made after the specified migration plan according to the migration order.

Canceling an auto migration plan

The Cancel Plan button on the Auto Migration window allows you to cancel the existing auto migration plan. You need to cancel the existing auto migration plan and turn off auto migration before performing any manual migration operations.

To cancel an auto migration plan:

1. On the main window, click the **Auto** button.
The Auto Migration window opens.
2. Review the existing migration plan and confirm that you want to cancel the entire plan.
3. Click the **Cancel Plan** button.
4. When the cancel plan confirmation message is displayed, click **OK** to cancel the plan or click **Cancel** to cancel your request.

If one or more auto migration operations are not removed from the Generated Migration Plan box, the auto migration plan is already in process. You can use **Delete** on the Volume List window to stop and cancel an auto migration operation that is in progress.

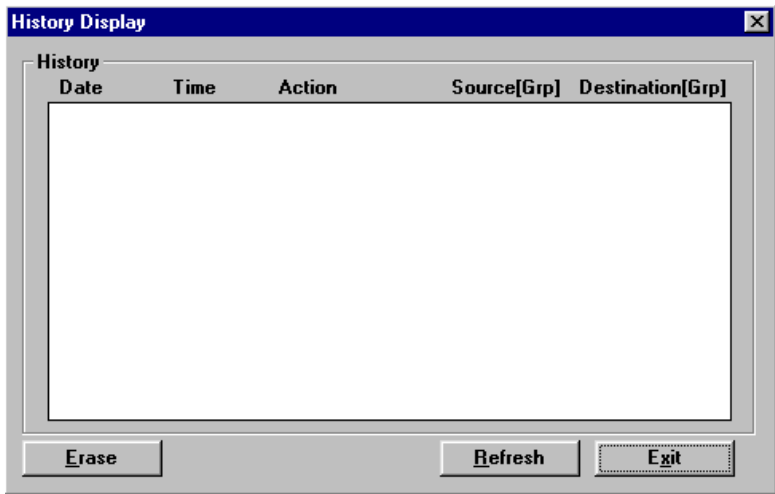
Viewing the migration history

Auto LUN logs all volume migration operations in either the manual or auto migration history logs.

Viewing the manual migration history log

The Auto LUN logs all manual Auto LUN migration operations in the manual migration history log. The History Display window displays the manual history log and allows you to delete the entries from this log.

Click **History** on the Auto LUN main window.



- | | |
|-----------------------|---|
| Erase button | Allows you to remove any/all entries from this History log. |
| Refresh button | Refreshes the information displayed on the window. Each history log entry is displayed by date, time, action, source volume, and target volume. |
| Action column | Messages include:
Migration Start: Started migrating volumes.
Migration Complete: Migration was finished. |

Migration Cancel:	Migration was canceled.
Migration Failed:	Migration failed.
Migration Give Up:	Migration was aborted.

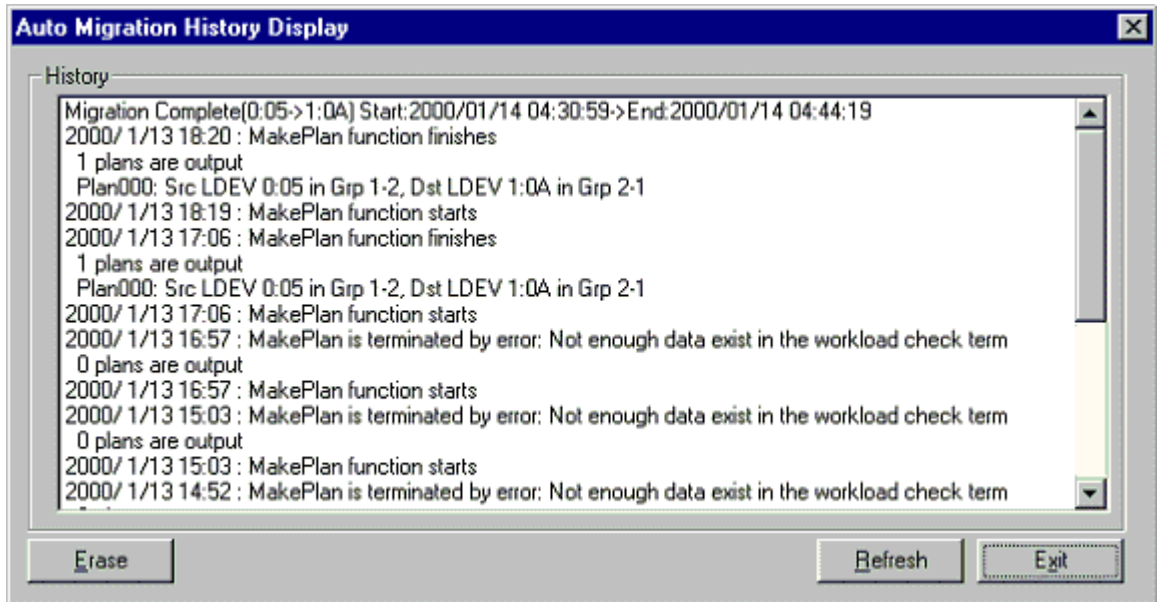
Source(Grp) Source volume (LDEV ID) and parity group.

Destination(Grp) Target volume and parity group.

Viewing the auto migration history log

The Auto LUN logs all auto migration operations in the auto migration history log. The Auto Migration History Display window displays the auto migration history log and allows you to delete the entries from this log.

To display the Auto Migration History Display window click **History Log** on the Auto Migration window ([page 67](#)).



Erase button Allows you to remove entries from the history log.

Refresh button Refreshes the information displayed on the window.

Migration history log entry formats

Format	Description
Migration Complete (<i>CU:LDEV->cu:ldev</i>) Start:yyyy/mm/dd hh:min:sec -> End:yyyy/mm/dd hh:min:sec	Normal end of migration.
Migration Canceled (<i>CU:LDEV->cu:ldev</i>) Start:yyyy/mm/dd hh:min:sec -> End:yyyy/mm/dd hh:min:sec	Migration canceled: over the limit duration.
Migration Canceled (<i>CU:LDEV->cu:ldev</i>) Start:yyyy/mm/dd hh:min:sec -> End:yyyy/mm/dd hh:min:sec (reason)	Migration canceled: other reason.
Migration Canceled (<i>CU:LDEV (X-X)->cu:ldev (X-X)</i>) yyyy/mm/dd hh:min:sec (Invalid Parity Group)	Migration canceled: invalid parity group.
Migration Plan deleted (<i>CU:LDEV->cu:ldev</i>) yyyy/mm/dd hh:min:sec (Pre-Plan is deleted)	Deleted the migration plan. A migration plan was deleted because the previous plan had been deleted.
yyyy/mm/dd hh:min: MakePlan function starts	The program starts making a plan.
yyyy/mm/dd hh:min: MakePlan function finishes	The program ends making a plan.
<i>n</i> plans are output	The program outputs the number of plans.
Plan: Src Hdev <i>CU:LDEV</i> in Grp <i>p-p</i> , Dst Hdev <i>cu:ldev</i> in Grp <i>p-p</i>	The program made the plan.
yyyy/mm/dd hh:min: MakePlan is terminated by error: <i>message</i>	The program failed to make plans.
Cannot make plan: Class X Grp <i>p-p</i>	The plan of a certain group in the indicated class could not be made.
<i>n</i> samples are invalidated because of migration	To reduce the influence of migration in the workload check term, the program made a plan without some samples.

(continued)

Format	Description
New entries are added for following HDEVs: <i>CU:LDEV, cu:ldev. . .</i>	According to changing the volume configuration, the program added the information against those added volumes.
Too many invalid data: invalidated all data	The contents of data in the indicated group or volumes is invalid. The program made a plan without that data.
Utilization Check failed	The program failed to check the volume utilization because it could not get the necessary data in this check. Get the data again.
Reserve Volume Check failed	The program failed to check the volume attributions. The program could not get the necessary information.

Migration history log entry fields

Field	Description
<i>CU:LDEV</i>	Original logical device (source volume).
<i>cu:ldev</i>	Target logical device (target volume).
<i>Start:yyyy/mm/dd hh:min:sec</i>	Copy start time.
<i>End:yyyy/mm/dd hh:min:sec</i>	Copy end time.
<i>n</i>	Number.
<i>Grp p-p</i>	Parity group including the source volume.

(continued)

Field	Description
<i>reason</i>	No Reserve Volume
	No reserved volume is set. Make the plan again.
	Reserve Volume Emulation is different
	The reserved volume's emulation type is different.
	Utilization Check
	The usage rate is over the limited rate, or there is no monitoring data.
	Migration failed. Error Code: <i>n</i>
	The indication of the migration was failed.
	Reserve Volume Size is different
	Reserve volume size is different.
	Reserve Volume emulation is not supported
	The emulation type of reserved volume is not supported.
	Utilization Check failed
	The utilization rate check finished abnormally.
	Reserve Volume Check failed
	The reserved volume check finished abnormally.

(continued)

Field	Description
<i>message</i>	<p>Cannot make proper migration plan by this function</p> <p>The program could not make a proper migration plan. Check the number of the reserved volumes and their locations. Check the limit number of disk utilization and change if necessary.</p> <hr/> <p>Not enough Auto LUN data in the workload check term</p> <p>The program did not have enough data to make the plan in the target term. Check the monitored data and gather the data again if necessary. Check the workload check term.</p> <hr/> <p>Failed to get <i>string</i></p> <p>The program failed to get the information or data to make a plan. In the case of information: Make the initial value again by clicking [Default]. In the case of data: Check the status of gathered data and get the data again.</p> <hr/> <p>Failed to write to <i>string</i></p> <p>The program failed to write the information to make a plan, where <i>string</i> is invalid information or data.</p> <hr/> <p>Invalid <i>string</i></p> <p>The program needed the information to make the plan, but could not use it because the information was invalid, where <i>string</i> is invalid information or data. In the case of information: Use the initial value again by clicking [Default]. In the case of data: Check the status of gathered data and get the data again.</p> <hr/> <p>Memory allocation error</p> <p>The program failed to allocate the memory to make the plan.</p>

Making a graph of Auto LUN monitoring data

Auto LUN has a monitoring function that outputs statistic information to a floppy disk so that you can draw graphs. These graphs visually show the time-based transition of information. This function is part of the Auto LUN program product, and is provided on an installation floppy disk.

Graphs of utilization data can be produced using the supplied GraphTool software described in Chapter 4, or you can create graphs using Excel as explained below.

To run the graphing function, you need a PC with a Microsoft Windows environment:

- Microsoft Windows 95/98/NT
- Microsoft Excel 97 or later
- 1 MB of hard drive capacity to install the graphing function.
- 5 MB of hard drive capacity to store statistic information files and some temporary files to unfreeze files. This capacity changes according to system configuration and how long statistic information is captured.
- A floppy disk (or other media) to save the statistic information created by Auto LUN.

Excel installation

To install the Excel graphing module:

1. Make a folder for installation on the PC.
2. Copy a file named **hihsm.exe** from the installation floppy disk to the folder made at step 1.
3. Run **hihsm.exe**.
4. Confirm that the files of the Excel Graphing Module listed in the table below are present.

Caution *According to the setting of file display option of Explorer, some files such as **Rmt_cmn.dll** and some file extension names may not display. In this case, change the setting of file display option of Explorer to display all files and extensions.*

The Excel graphing module files shown in the table below are created at installation. If a file listed in the table is not present, delete all the files and retry installation from the beginning.

File Name	Content
Pmrfg.xls	Excel macro for drawing graph
Hiertxt.exe	Translator of statistic information to text
Rmt_cmn.dll	Dynamic link library for translation
unlha.dll	Dynamic link library for unpacking

Making a graph using Excel

1. Copy the **artlog.lzh** file from the floppy diskette to the folder that contains the Auto LUN graphing function files.
2. Run **Hiertxt.exe** to extract the monitoring data to data files.
3. Create a folder for the disk array and use the serial number of the array to identify the folder (for example, c:\AutoLun\30007).
4. Extract the data files (**YYMMout.dat**).
Each data file contains the monitoring data for the year (YY) and month (MM) identified in the file name (for example, the **0002out.dat** file contains data for year 00 (2000) and month 02 (February)).
5. Exit **Hiertxt.exe**.
6. Launch Excel.
7. Run the macro **Pmrfg.xls** located in the folder that contains the Auto LUN graphing function files.
8. Select the desired **YYMMout.dat** file and click **OK**.

The Graph window opens.

9. Select the desired type of graph from the list below and verify the monitoring data term to be graphed.

Name	Content
CHA Processor	CHIP MP usage
DKA Processor	ACP MP usage
DRR	DRR usage
Bus	F-BUS, M-BUS usage
Disk (Parity Group)	Parity group usage
Disk (Volume)	LDEV usage. This graph is created by parity group.

10. Click **Change**.
11. Select the desired data term (minimum 15-minute intervals) and then click **OK**.

The Available term field displays the earliest and latest monitoring data, which may not include all data samples between these two dates/times. If you select a term that does not contain any monitoring data, the graphs will show 0 for all data points.
12. If you selected the Disk (Volume) graph type, click **Forward**, select the desired parity group, and then click **OK**.
13. After you have selected the desired graph options, click **Finish** to display the specified data in the specified graphical format.

Installing and using GraphTool

Auto LUN allows you to export data collected during monitoring, such as hardware performance, cache usage, and I/O statistics. The GraphTool software included with Auto LUN displays the monitoring data graphically, which highlights key information such as peaks and trends.

This chapter describes the following procedures:

- Using GraphTool to analyze your monitoring data
- Installing and uninstalling the GraphTool software
- Starting and exiting the GraphTool software
- Extracting the data from the log file
- Displaying the data graphs
- Viewing the data graphs
- Exporting GraphTool data as text
- Printing the data graphs
- Closing the data graphs

Using GraphTool to analyze monitoring data

The GraphTool software for Auto LUN enables you to extract monitoring data from the **artlog.lzh** export file and graph the data in several graphical formats. This section provides an overview of the types of performance analyses that can be done using the monitoring data and GraphTool. Use the general information presented here to tailor graphics to your own needs.

Analyzing MP usage

The microprocessor (MP) usage data (CHPs and DKPs) provides a quick measure of general hardware performance and can also highlight bottlenecks in subsystem activity. If you find that the CHP and/or DKP usage is consistently very high, this could indicate the need for additional front-end and/or back-end paths for the subsystem.

Another possible cause for high MP usage is a group of LDEVs in the same array domain which receives unusually heavy usage. In this case, you can correlate the DKP usage data with the LDEV usage data to identify the busiest devices and then use Auto LUN to spread the data across LDEVs in different array domains or even across LDEVs in different subsystems.

The MP usage data can also be correlated with the I/O statistics to see how various types of workloads affect subsystem performance. For example, write-intensive workloads (identified by reviewing the R/W ratio data) can have a significant impact on subsystem I/O response times. If periods of unusually high DKP usage correlate with write-intensive workloads, you can prevent or minimize any decrease in subsystem performance by spreading the data across different array domains or even across different subsystems.

Analyzing I/O statistics

The I/O statistics, available at the parity group and LDEV levels, can be used to identify the characteristics of the various workloads and jobs. For example, the R/W statistics show whether jobs are write-intensive or read-intensive, and the I/O rate graphs highlight workloads which consist mainly of sequential I/O operations (batch processing operations such as backup/restore or sort operations). You can correlate the I/O statistics with the MP and cache usage data to analyze disk array performance according to workload type. For example, you can compare the R/W ratio and I/O rate data with the CHP and DKP usage data to determine if a disk array requires additional front-end and/or back-end paths. In addition, you can vary the job mix and repeat these performance analyses to determine the impact of different workload configurations on array performance.

Analyzing LDEV-specific data

By reviewing the LDEV usage data, you can find “hot spots” of LDEV activity, that is, specific LDEVs that are often very busy while others show normal usage. These LDEVs can be identified by analyzing the LDEV-level usage. If certain LDEVs consistently experience very high usage, this can degrade I/O response times. You have several options for resolving this situation:

- Spread the data stored on these LDEVs across more LDEVs, across LDEVs in different array domains, and/or across LDEVs in different subsystems
- Add more backend paths
- Utilize the Virtual LVI/LUN features
- Add more disk storage space

Installing and uninstalling GraphTool

The GraphTool software requires the following operational environment:

- A Windows PC with a floppy diskette drive (to access the **a:\artlog.lzh** file) and a CD drive (to install the GraphTool software).
- At least eight MB of free space (three MB to install GraphTool, about five MB when using GraphTool). More free space may be required depending on the configuration of the disk array whose monitoring data you are analyzing (number of parity groups, DKPs, volumes) and the range of monitoring data being analyzed (size of **artlog.lzh**).

Installing the GraphTool software

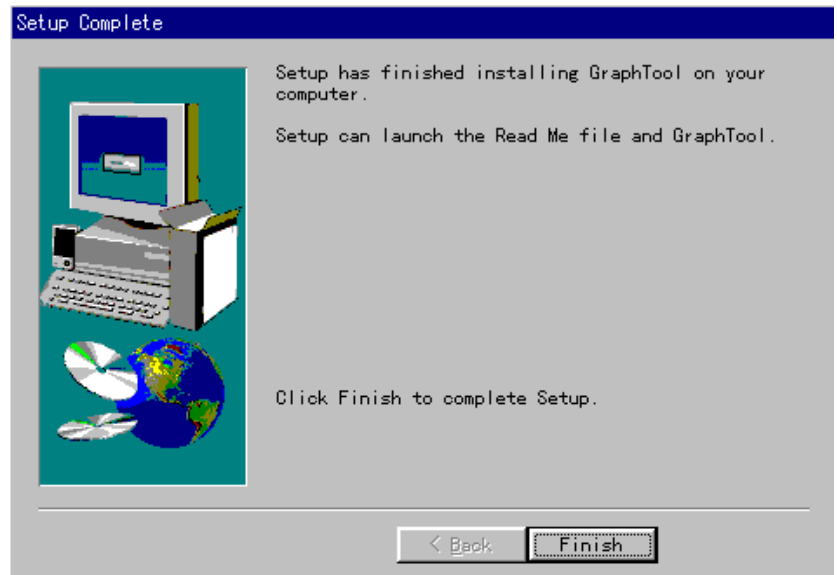
1. Run **setup.exe** in the installation CD. The Welcome window opens.
2. In the Welcome window, click **Next** to open the Choose Destination Location window. If you want to use the default installation folder, click **Next**. If you want to change the installation folder, click **Browse...** and enter the desired location.



3. Installation starts, and the files are copied to the specified folder.



4. When installation is complete, the Setup Complete window opens.



5. Confirm that the files specified in the following table were created. Then click **Finish**.

Certain Windows folder and file display options may hide some of these files (e.g., the two **dll** files) and/or the file extensions. Please change the folder and file settings so that you can verify all graphing function files by file name and file extension.

File Name	Graphing Function
GTool.exe	Graphing function execution.
GraphTool.exe	Graphing tool launcher displaying the copyright dialog box. (This file gives parameters for starting the graphing tool.)
MFC42.dll	Dynamic link library for MFC.
MSVCRT.dll	Dynamic link library for starting the graphing tool.
R40cmn.dll	Dynamic link library for Remote Console program.
RMTCMN32.dll	Dynamic link library for Remote Console program.
unlha32.dll	Dynamic link library for unpacking.
DATRD400.dll	Dynamic link library for reading graphing tool data.
DATRD300.dll	Dynamic link library for reading graphing tool data.
GRTDATRD.dll	Dynamic link library for reading graphing tool data.
oemtype	OEM type data

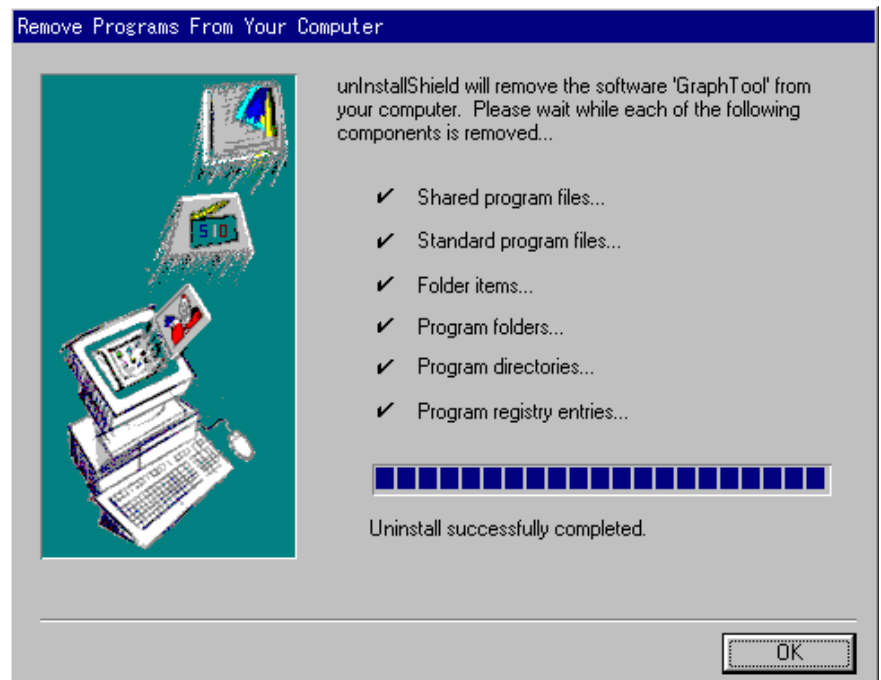
Viewing the GraphTool version information

To check the GraphTool program version information:

1. On the GraphTool main window click **About GraphTool...** from the Help menu, or select the help icon to display the GraphTool version information.
2. Click the **OK** button to close the version information window.

Uninstalling the GraphTool

1. From the Windows Start menu, click **Setup**, click the **Control** window, and then click **Adding and Deleting Applications**.
2. Click **GraphTool**, and then click the **Add and Delete** button.
3. When the confirmation message appears, click **Yes** to uninstall the GraphTool. The Uninstall Shield starts, and the corresponding program files are deleted.



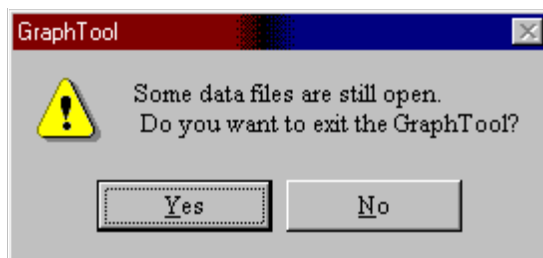
Starting and Exiting GraphTool

To start the GraphTool software:

1. From the Windows Start menu, select **Program Files**, and then select GraphTool. Or, you can double-click the **GraphTool.exe** file in the GraphTool installation directory.
2. The GraphTool main window opens. The GraphTool main window provides access to all GraphTool functions.

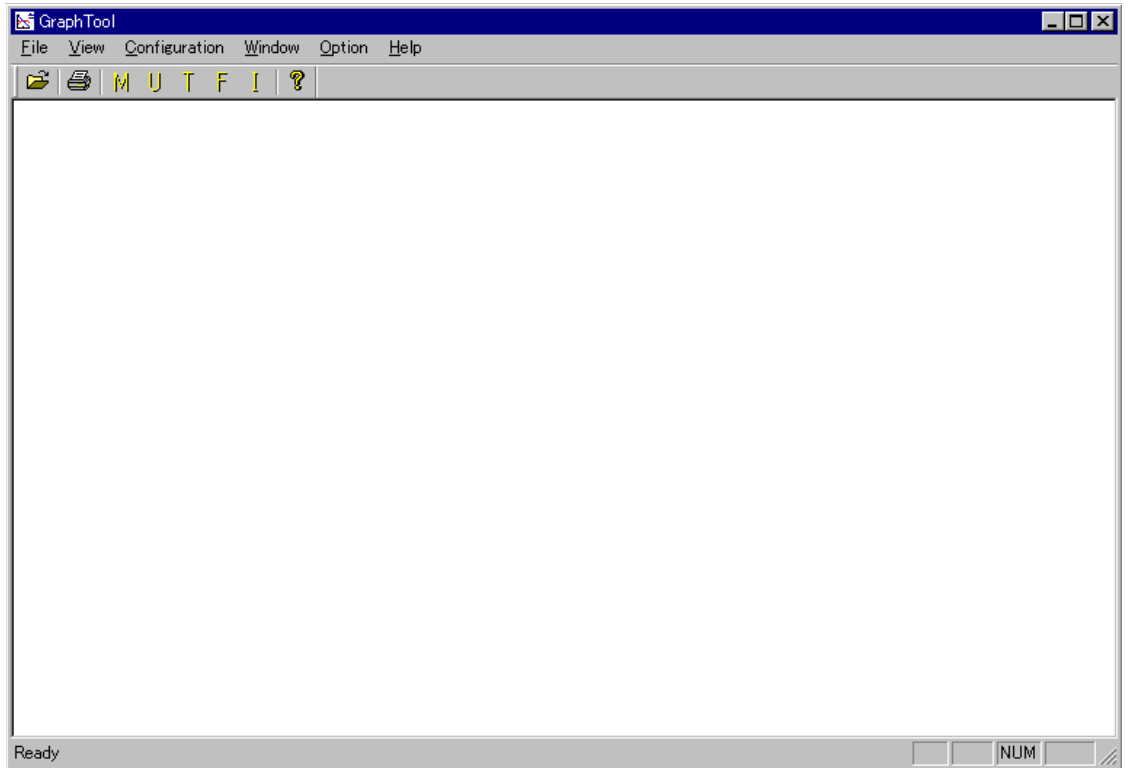
To exit the GraphTool software:

3. On the GraphTool main window, select the **File** menu, and then click Exit.
4. If a GraphTool window is open, a confirmation message is displays. Click **Yes** to exit GraphTool, or click **No** to cancel your request.



GraphTool main window

When you start the GraphTool software, the GraphTool main window opens. The GraphTool main window provides access to GraphTool menus and functions.



File menu

The File menu provides the following commands for manipulating data files:

Open: Opens a data file for which you want to create a graph.

Close: Closes the current data file which is open for graphing.

Print: Prints the graph currently displayed on the screen.

Print View: Displays the print preview image for the current graph.

Print Setup: Displays the screen for setting up the print options.

Exit: Terminates the GraphTool software, and closes the GraphTool main window.

View menu

The View menu displays the following commands for specifying the window features:

Tool Bar: Allows you to specify whether or not to display the toolbar.

Status Bar: Allows you to specify whether or not to display the status bar.

Configuration menu

The Configuration menu provides the following commands for creating graphs:

Module: Opens the Select Module window, which allows you to specify the graph module to be displayed.

Unit: Opens the Select Unit window, which allows you to select specific LDEVs to be displayed on the graphs.

Term: Opens the Select Term window, which allows you to specify the data term to be displayed on the graphs.

Font: Opens the Font window, which allows you to change the font settings for the graphs.

Show Data Information: Opens the screen which displays the log file information.

Window menu

The Window menu provides the standard commands for displaying the open window(s):

New Window: Opens a new graph display window.

Cascade: Displays multiple graph display screens (windows) on different layers.

Tile: Displays multiple graph display screens (windows) by arranging them on a screen.

Arrange Icons: Displays multiple graph display screens (windows) as icons arranged on the bottom left side of the GraphTool main window.

Option menu

The Option menu provides the following commands for setting options and exporting data:

Default Directory: Allows you to change the default log data directory.

Save Option: Allows you to save your changes to the default log data directory.

Export window data: Allows you to export the data being selected in the currently active window to a text file.

Export all module data: Allows you to export all data in the currently loaded data module to a text file.

Help menu

The Help menu provides the About GraphTool command, which displays the version information for the GraphTool software.

Toolbar

The toolbar provides the following icons for the frequently used menu commands:



: File-Open command.



: File-Print command.



: Configuration-Module command (opens the Select Module window).



: Configuration-Unit command (opens the Select Unit window).



: Configuration-Term command (opens the Select Term window).



: Configuration-Font command (opens the Font window).



: Configuration-Show Data Information command.

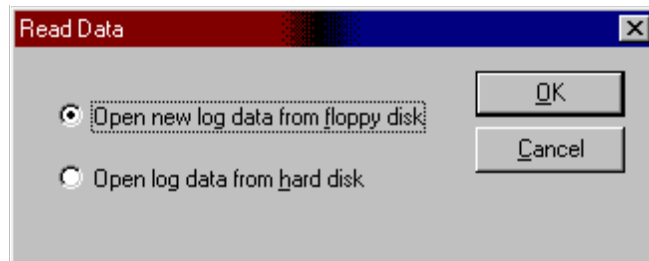


: Help-About GraphTool command.

Extracting the data from the log file

The Read Data window allows you to specify the location of and extract the data from an Auto LUN export file (log data). After you have extracted the data from the specified file, you can start displaying the data as graphs.

To open the Read Data window, select **Open** from the File menu or icon on the GraphTool main window.



The **Open new log data from floppy disk** option allows you to read and extract data stored on one or more floppy disks.

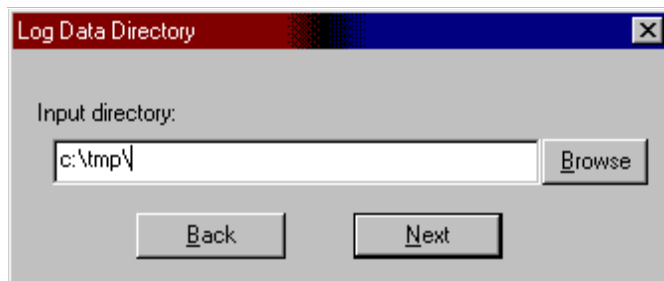
The **Open log data from hard disk** option allows you to read and extract data stored on the hard disk drive. When reading data from floppy disk, GraphTool also saves the data on the hard disk drive.

Caution *Only one statistical information file (log data) can be stored in the log data directory. The user is responsible for backing up log data as needed prior to reading and extracting data from floppy disk.*

Extracting log data on floppy disk

To extract a log data file stored on one or more floppy disks:

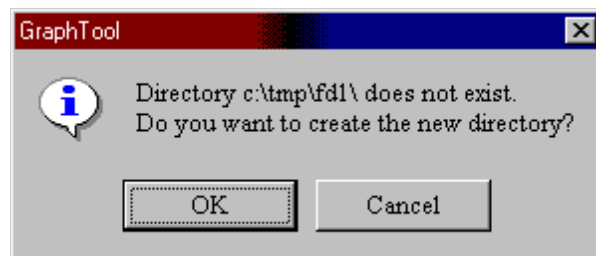
1. Open the Read Data window (File-Open), click **Open new log data from floppy disk** and then click the **OK** button.



2. The Log Data Directory window opens. On the Log Data Directory window, specify the GraphTool log data directory (folder). GraphTool will save the log data on the floppy disk(s) into this directory. To find an existing directory, click the **Browse** button, and then locate and click the directory. Click the **Next** button to continue.

If the specified directory does not exist, GraphTool displays a confirmation message for creating the new directory. Click **OK** to create the new directory, or click **Cancel** to return to the Log Data Directory window.

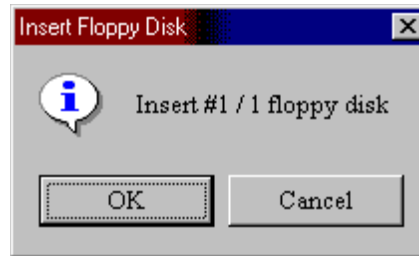
If a log data file (**log.lzh**) already exists in the specified directory, GraphTool displays a confirmation message. If you want to *OVERWRITE* the existing log data with the data stored on floppy disk, click **OK**. If not, click **Cancel** to return to the Log Data Directory window.



3. When the log data directory is ready, the Number of Floppy Disks window opens. Enter the number of floppy disks containing the statistical data, and click **Next**.



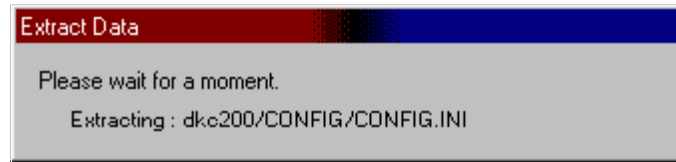
4. The Insert Floppy Disks window opens and displays the disk number to be inserted (#1/1, #1/3). Insert the specified floppy disk into the disk drive, and click **OK**. To return to the Number of Floppy Disks window click **Cancel**. Repeat this step as needed until the data has been read from all specified floppy disks.



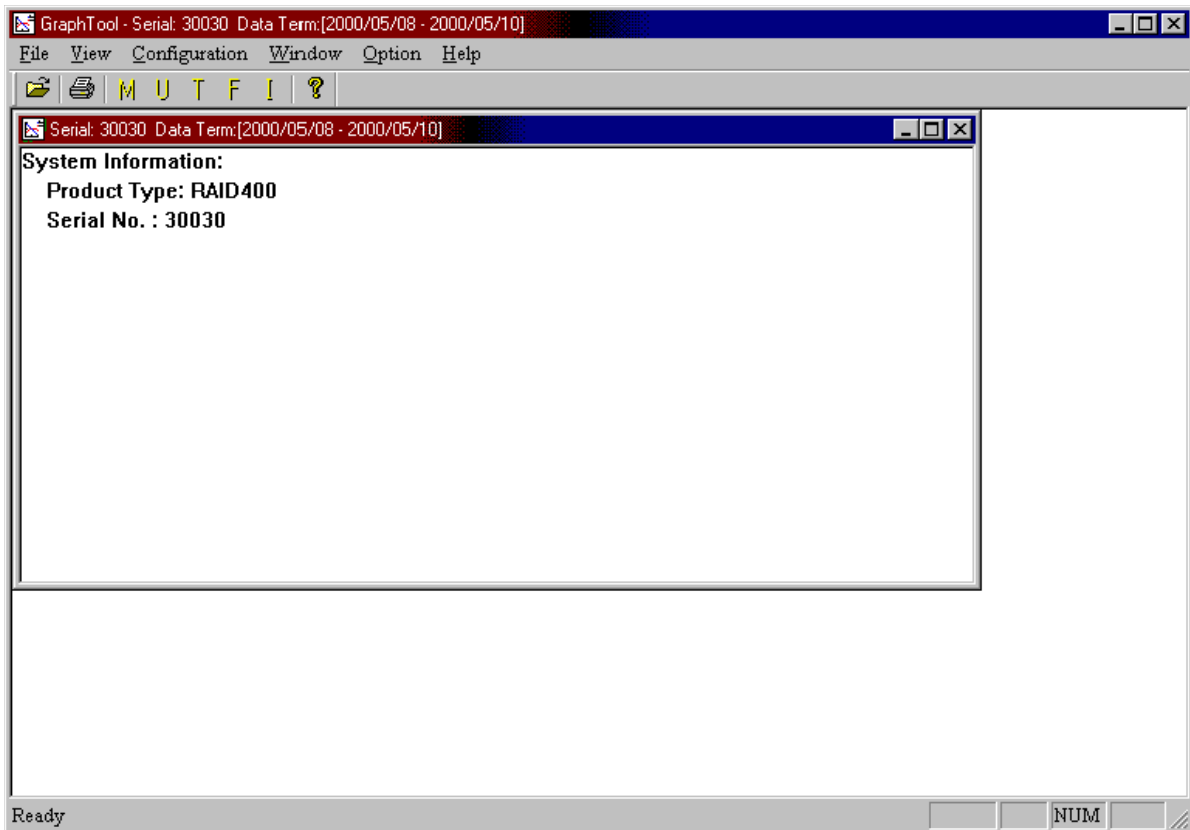
5. When the data has been read from all floppy disks, a message prompts you to eject the last floppy disk. Eject the floppy disk from the drive, and click **OK**.



6. The Extract Data window now opens, and data extraction begins in the specified folder on your hard drive.



7. When data extraction is complete, GraphTool loads the initial data and displays the following information about the data file: disk array model, serial number, and data term (range of available data).



Extracting log data on the hard disk

To extract a log data file stored on the hard disk drive:

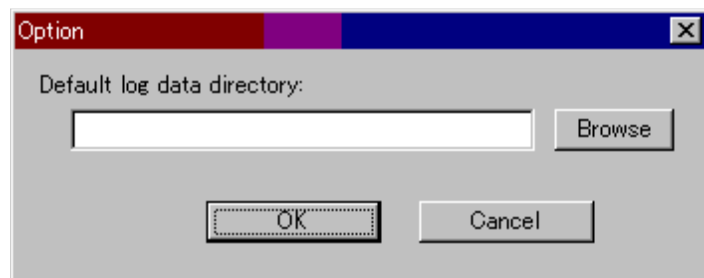
1. Open the Read Data window (File-Open), select **Open log data** from hard disk, and then click the **OK** button.
2. When prompted, specify the desired log data file (e.g., **log.lzh**), and click the **Open** button. To open the last file you previously opened, select **Recent File** from the File menu.
3. The Extract Data window opens, and data extraction begins.
4. When data extraction is complete, GraphTool loads the initial data and displays the following information about the data file: disk array model, disk array serial number, and data term (range of available data).

Specifying the default log data directory

As a program option, GraphTool allows you to specify a directory (folder) as the default log data directory. This location will be entered automatically during GraphTool operations, so that you do not have to enter the log data directory location.

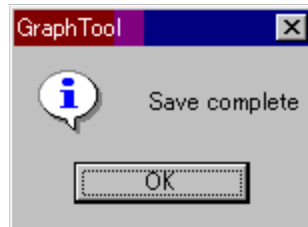
To specify the default log data directory for GraphTool operations:

1. On the GraphTool main window, select the **Option** menu, and then select **Default Directory** to open the Option window.



2. On the Option window, enter the desired directory in the Default log data directory text box using an absolute path (e.g., c:\tmp\logdata\). To find an existing directory, click the **Browse** button, locate the desired directory, and click **OK**.

3. When the directory entered on the Option window is correct, click **OK**. If the specified directory does not exist, a confirmation message for creating the new directory is displayed. Click **OK** to create the new directory, or click **Cancel** to return to the Option window.
4. After you have set the new default log data directory location, you need to save this information. Select the **Option** menu on the GraphTool main window, and then select **Save Options** to save the new log data directory location.
5. When the save completion message appears, click **OK**.



Displaying the graphs

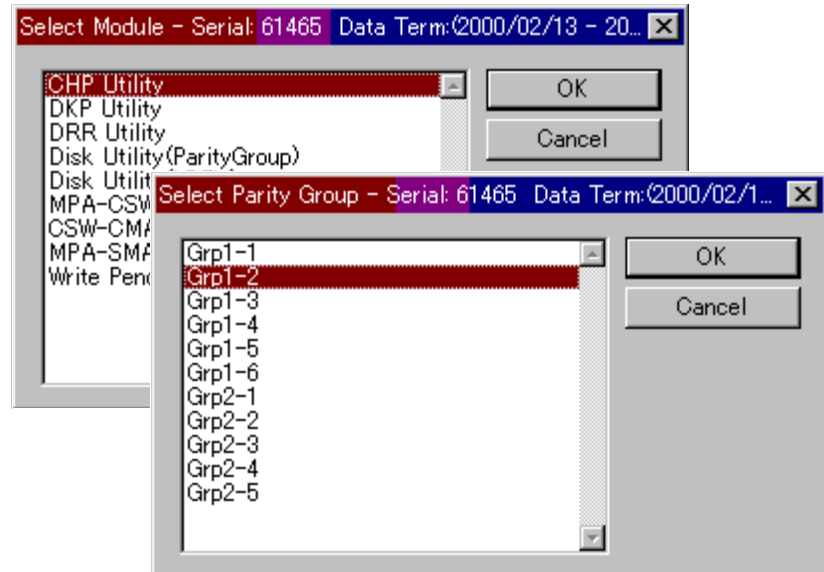
GraphTool allows you to specify the following parameters when displaying data graphs:

- Data module (e.g., CHP usage, DKP usage)
- Parity group (for the Disk Utility (LDEV) module only)
- Data term (start and end date/time), plotting scale (data interval), and plotting method (actual, average, or maximum values)
- LDEV(s) (for the Disk Utility (LDEV) module only)

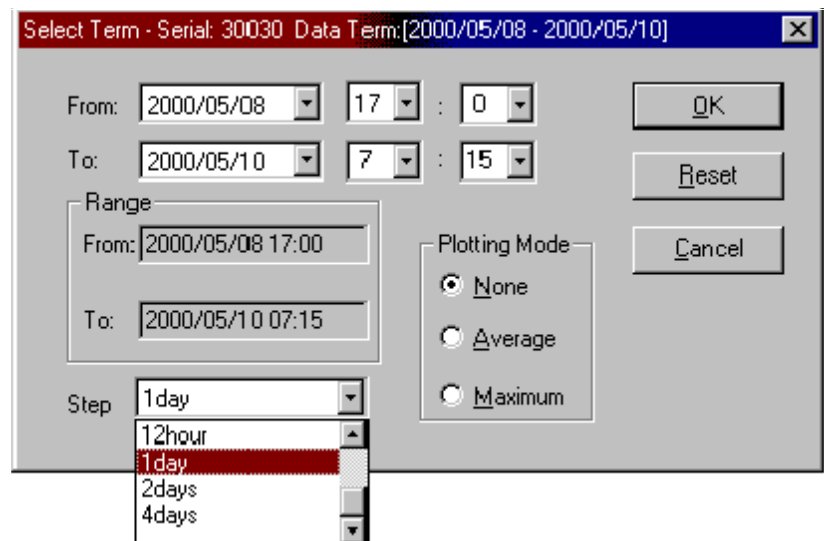
While graphs are being displayed, you cannot perform any other GraphTool operations.

To display the disk array monitoring data as graphs:

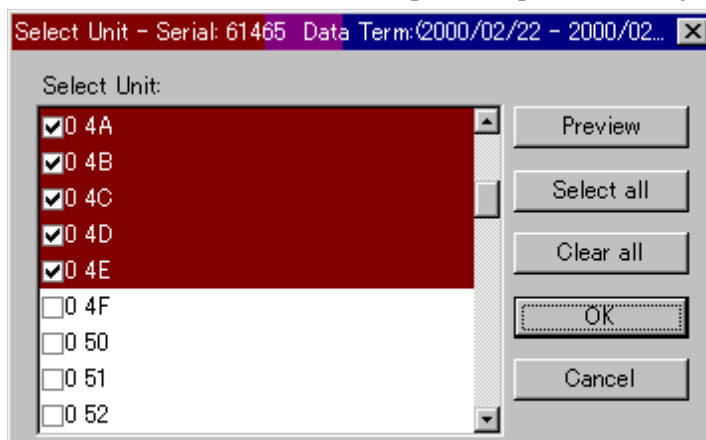
1. Make sure that the desired log data file has been extracted using the Read Data window.
2. Open the Select Module window, select the data module that you want to display, and then click **OK**. If you select the Disk Utility (LDEV) module, the Select Parity Group window opens automatically. Select the desired parity group, and click **OK**.



3. After the data module has been selected, the Select Term window opens automatically. Select the desired data term, step (graph scale), and plot mode, and then click **OK**. The monitoring data is loaded from the location specified on the Read Data window.

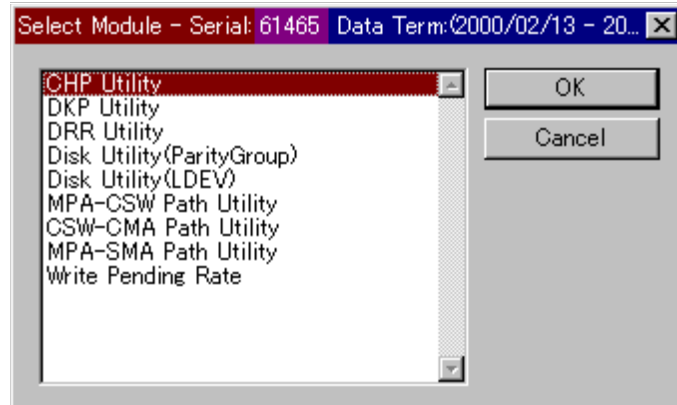


4. After the data term has been selected and the data has been loaded, the Select Unit window opens automatically. Select the desired units (LDEVs) for which you want to display graphs. If you want to check a graph for an LDEV before continuing, click the Preview button. When you are finished selecting LDEVs and previewing graphs, click **OK** to close the Select Unit window and plot the specified data graphs.



Selecting the data module

The Select Module window allows you to specify the data module to display. To open the Select Module window, select **Module** under the Configuration menu, or select the icon on the toolbar on the GraphTool window.



The Module list box lists the data modules available for graphing:

CHP Utility: Actual, average, and maximum usage rates of the CHPs.

DKP Utility: Actual, average, and maximum usage rates of the DKPs.

DRR Utility: Actual, average, and maximum usage rates of the DRRs.

Disk Utility (Parity Group): Actual, average, and maximum usage rates of all parity groups.

Disk Utility (LDEV): Actual, average, and maximum usage rates of LDEVs of a specific parity group. If you select this module, the Select Parity Group window opens automatically to allow you to specify the desired parity group.

MPA-CSW Path Utility: Actual, average, and maximum usage rates of the paths between the adapters and CSWs (Adapter-CSW).

CSW-CMA Path Utility: Actual, average, and maximum usage rates of the paths between the CSWs and cache (CSW-Cache).

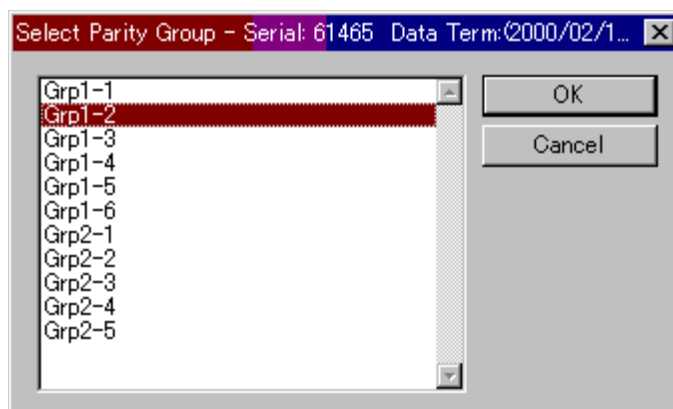
MPA-SMA Path Utility: Actual, average, and maximum usage rates of the paths between the adapters and SMs (Adapter-SM).

Write Pending Rate: Actual, average, and maximum rates of queued write I/Os.

If you selected the Disk Utility (LDEV) module, the **OK** button opens the Select Parity Group window to allow you to select the desired parity group. If you did not select the Disk Utility (LDEV) module, the **OK** button opens the Select Term window to allow you to specify the range of data to be displayed. The Cancel button cancels your request and closes the Select Module window.

Selecting the parity group

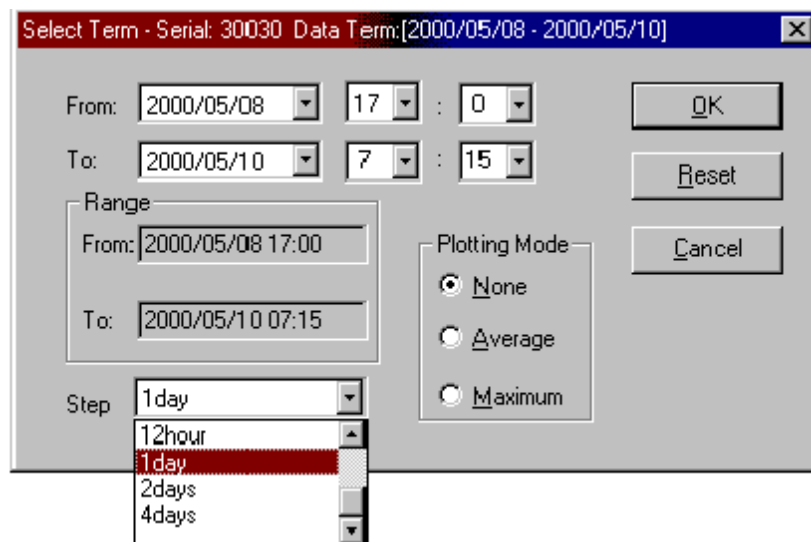
The Select Parity Group window allows you to specify the parity group to be displayed by the Disk Utility (LDEV) graph module. The Select Parity Group window opens automatically after you select the Disk Utility (LDEV) module on the Select Module window.



The Select Parity Group window displays the available parity groups and allows you to select the desired parity group. The OK button applies your selection and opens the Select Term window. The Cancel button cancels your request and returns you to the Select Module window.

Selecting the data term

The Select Term window allows you to select the data term, step (data interval), and plotting mode to be displayed on the graphs. The Select Term window opens automatically when you click **OK** on the Select Module window or Select Parity Group window. The Select Term window also allows you to change the data term, step, and/or plotting mode and replot a currently displayed graph.



The **From:** and **To:** combo boxes allow you to specify the term of data to be displayed on the graphs (within the range shown in the Range box). Select the start and end date (year, month, day), hour (0 - 24), and minute (0, 15, 30, 45). Note: The start time (From:) must be earlier than the end time (To:). You cannot enter values (e.g., 35) in the minute box.

The **Range** box displays the available range of data for the selected module. The Step combo box allows you to specify the scale of the graphs to be displayed: 15 minutes, 30 minutes, 1 hour, 2 hours, 6 hours, 12 hours,

1 day (default), 2 days, or 4 days. The Plotting Mode box allows you to specify the graph type as follows:

None: Allows you to plot a graph of the actual usage rate on the scale specified in the Step box. For example, if you specify 1 hour, the usage rate collected at times such as 01:00, 02:00, and 03:00 will be plotted.

Average: Allows you to plot a graph of the average usage rate during each interval on the scale specified in the Step box. For example, if you specify 1 hour, the average of the data collected during each hour (4 data points per hour) will be plotted.

Maximum: Allows you to plot a graph of the maximum usage rate during each interval on the scale specified in the Step box. For example, if you specify 1 hour, the highest data value collected during each hour will be plotted.

The **OK** button loads the statistical data according to the settings on the Select Term window and displays the Select Unit window.

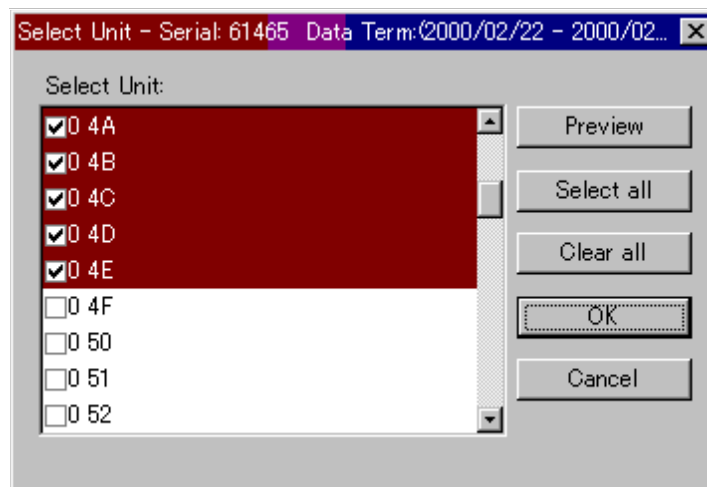
The **Reset** button resets the Select Term settings to default.

The **Cancel** button cancels your request and closes the window.

Selecting the units (LDEVs)

The Select Unit window allows you to select the logical devices (LDEVs) to be displayed on the graphs. The Select Unit window opens automatically when you click **OK** in the Select Term window. The Select Unit window appears only when the Disk Utility (LDEV) module has been selected.

The Select Unit window also allows you to change the LDEVs and replot the currently displayed graph. To open the Select Unit window while viewing a data graph, select **Unit...** on the Configuration menu, or select the unit icon on the GraphTool main window.



The **Select Unit** list box displays the available LDEVs (CU image, LDEV ID). The first sixteen units (starting from the lowest number) are selected by default. The **Preview** button displays graphs of the selected LDEVs, so you can check the data and appearance of the graphs in advance. The **Select all** button selects all LDEVs displayed in the Select Unit list box. The **Clear all** button deselects all LDEVs displayed in the Select Unit list box.

The **OK** button closes the Select Unit window and displays the Disk Utility (LDEV) graphs of the selected LDEVs. The **Cancel** button cancels your request and closes the Select Unit window.

Viewing the graphs

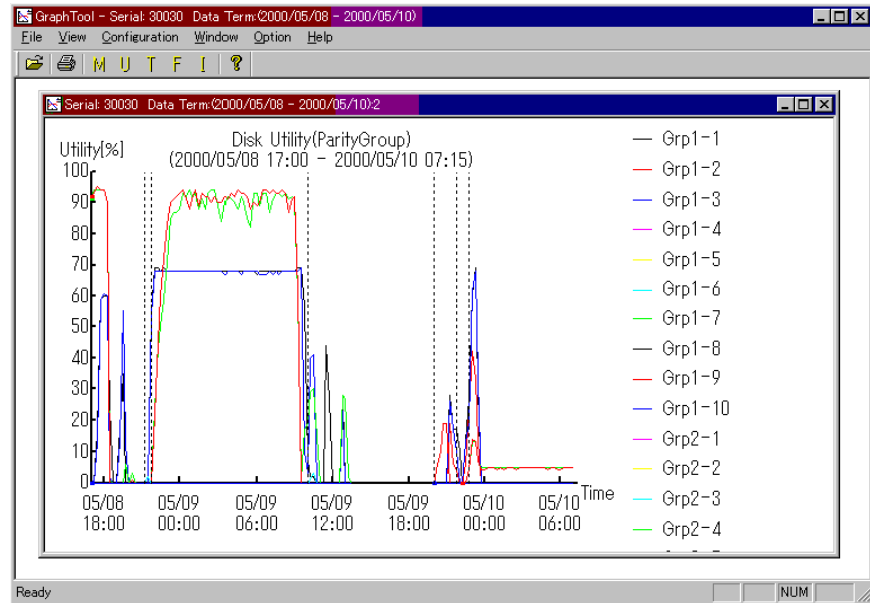
After you have extracted the log data and selected the data module and graph parameters, GraphTool loads and displays the requested data graph. The following figures show examples of the GraphTool data graphs. While data graphs are being displayed, GraphTool allows you to:

- Open additional graphs from the log data file which is currently open
- Highlight specific data on a data graph
- Change the data term, step (data interval), and plotting mode of a graph
- Change the LDEVs being displayed (Disk Utility (LDEV) module only)
- Change the font being displayed on the graphs

To save an image of the GraphTool window, use the system screen capture capability (**Alt-PrintScrn** to capture the active window).

Example Disk Utility (Parity Group) module line graph

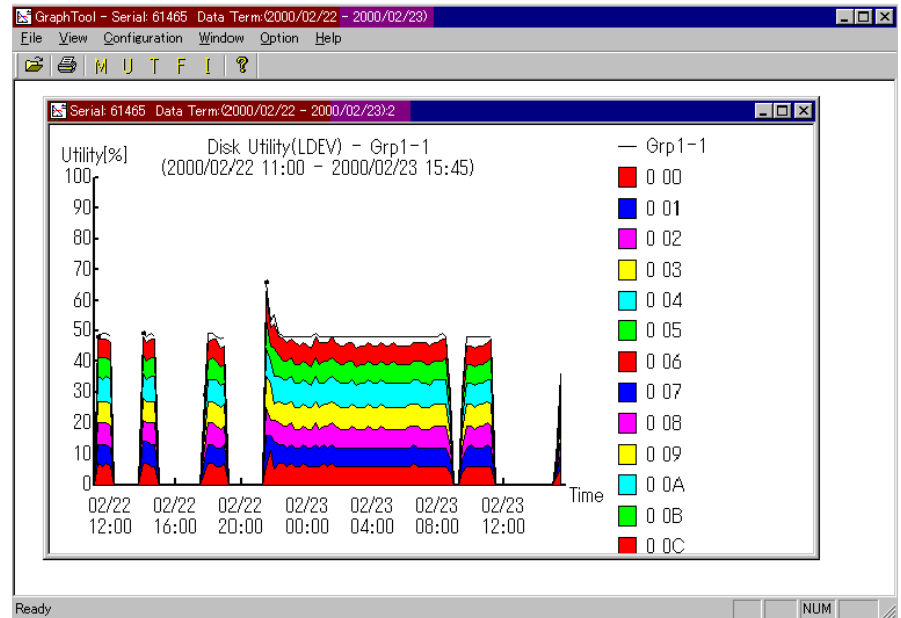
The figure below shows a line graph for the Disk Utility (Parity Group) module.



- The vertical axis displays usage rate (utility) from 0% to 100% in units of 10%.
- The horizontal axis displays the date and time of each data sample. The interval between data samples is set according to the step selected on the Select Term window.
- The module (selected on the Select Module window) is displayed at the top of the data graph.
- The legend is displayed along the right side of the data graph. You can select an item in the legend to highlight the corresponding graph on the left.
- When you specify None for the plotting mode in the Select Term window, a vertical dotted line appears if LDEV relocation occurred at least once in the time interval specified for that window.

Example Disk Utility (LDEV) module stacked area and line graph

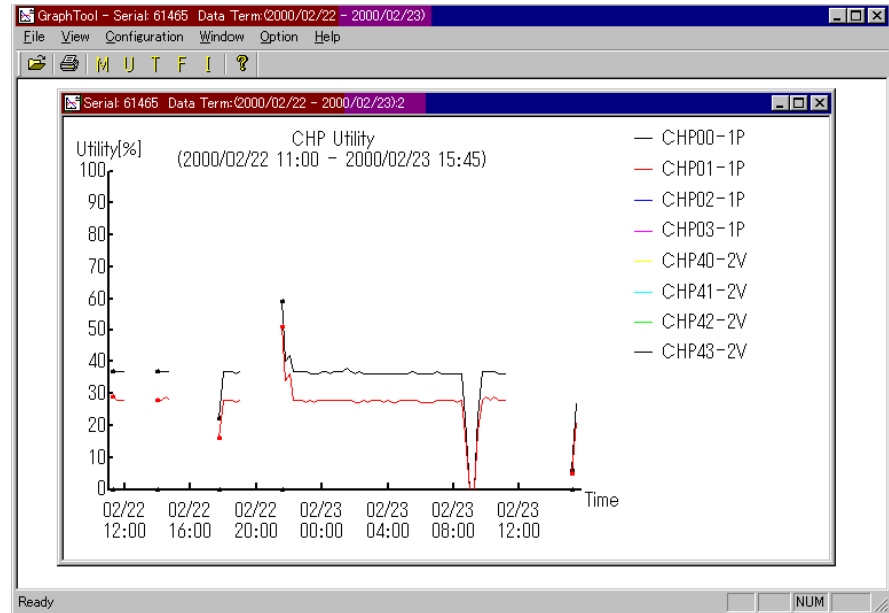
The figure below shows an example of a data graph for the Disk Utility (LDEV) module. This graph is a stacked area and line graph. An area plotted for each LDEV usage rate, and a line is plotted for the total usage rate of the parity group. If you specify **Maximum** for the plotting mode on the Select Term window, the total value may exceed 100%.



- The vertical axis displays usage rate (utility) from 0% to 100% in units of 10%.
- The horizontal axis displays the date and time of each data sample. The interval between data samples is set according to the **step** selected on the Select Term window.
- The module and parity group (selected on the Select Module and Select Parity Group windows) are displayed at the top of the graph.
- The legend is displayed along the right side of the graph. Click an item in the legend to highlight the corresponding graph on the left.

Example CHP, DKP, DRR, and Path Utility module line graph

The figure below shows an example of a data graph for the CHP Utility module. The CHP, DKP, DRR, and Path Utility data graphs have the same appearance. This graph is a line graph.



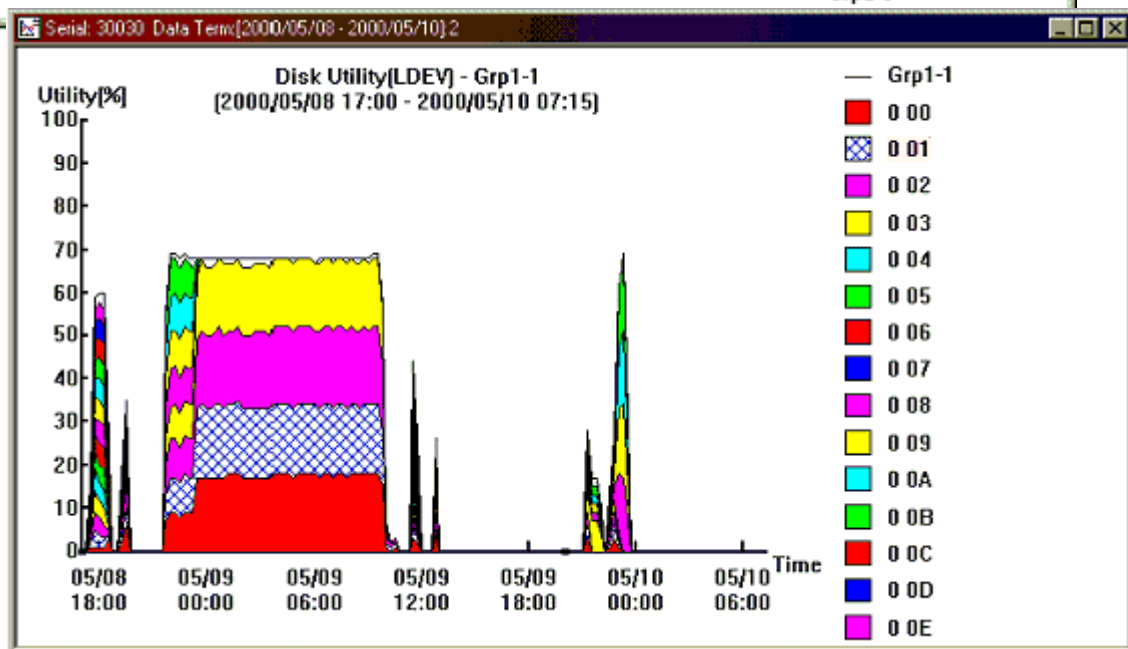
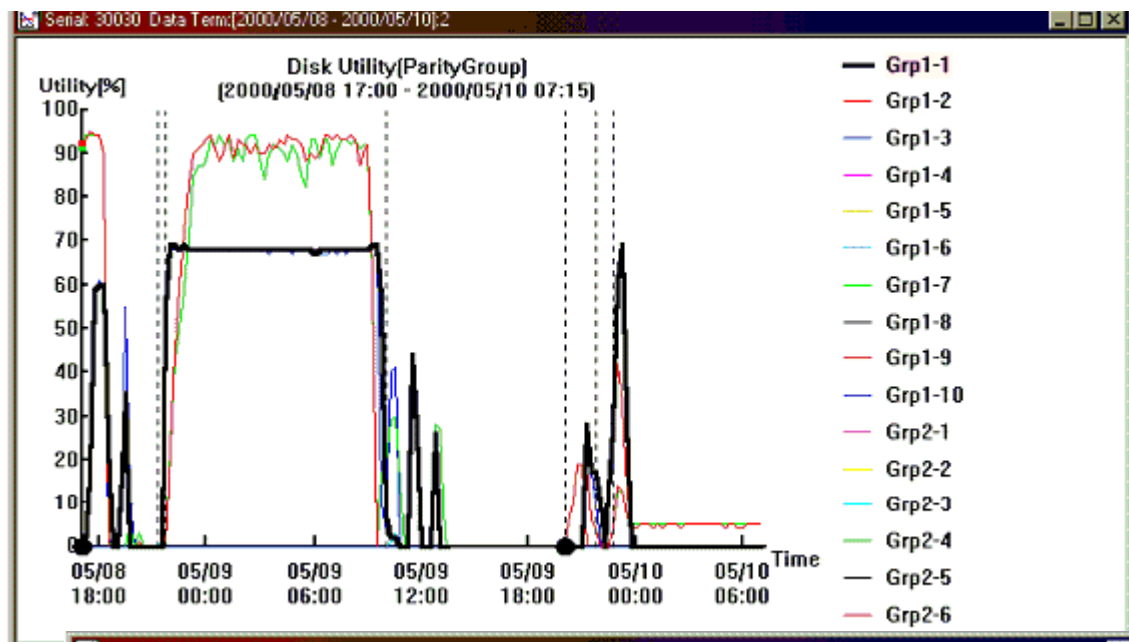
- The vertical axis displays usage rate (utility) from 0% to 100% in units of 10%.
- The horizontal axis displays the date and time of each data sample. The interval between data samples is set according to the **step** selected on the Select Term window.
- The module (selected on the Select Module window) is displayed at the top of the data graph.
- The legend is displayed along the right side of the data graph. Click an item in the legend to highlight the corresponding graph on the left.
- A dot is displayed at the beginning of a line graph and at the point where a line graph reappears after an interval.

Highlighting specific data on a graph

The legend on each data graph identifies the data being plotted by color. GraphTool allows you to select an item in the legend to highlight the corresponding data on the graph. See the example on the following page.

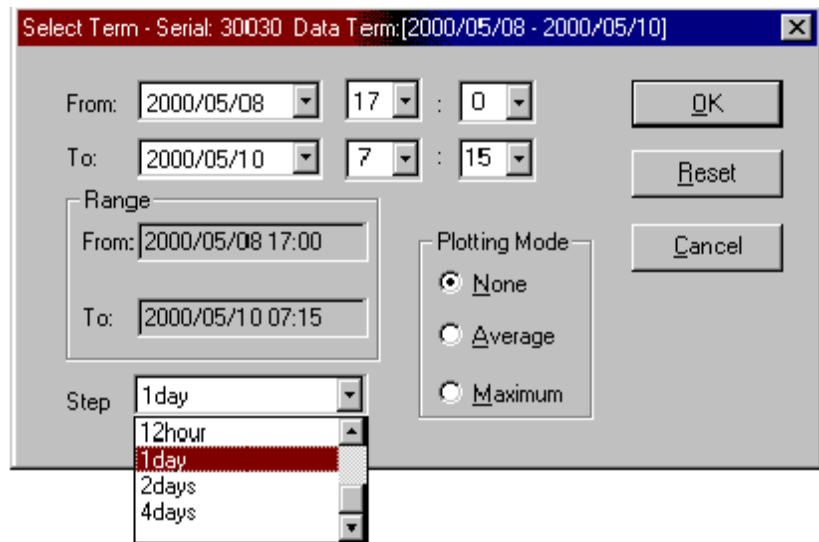
When you select a legend item, the background color of the item changes to pink. For a line graph, the highlighted line becomes thicker and moves to the foreground of the window. For a stacked area graph, the highlighted stacked area is displayed with a grid pattern. GraphTool also allows you to print graphs showing highlighted data.

The highlight is released when you select the same legend again, when you select another part of the window, or when you change the LDEVs using the Select Unit window.



Changing the data term, step, and plotting mode of a graph

The Select Term window allows you to change the data term, step (data interval), and/or plotting mode of and replot a currently displayed graph.

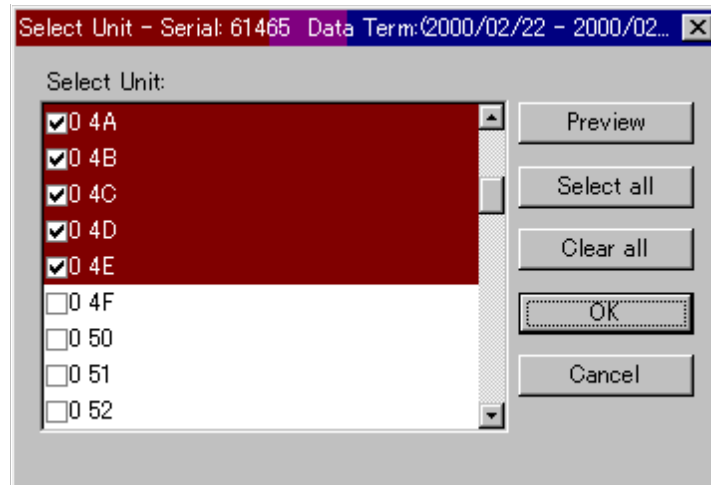


To change the term parameters for and replot a graph:

1. If more than one graph window is open, make sure that the desired window is active.
2. Open the Select Term window by selecting **Term** from the Configuration menu or by selecting the term icon on the GraphTool main window.
3. Change the parameters on the Select Term window as desired. To reset the parameters to the default settings, click **Reset**. To cancel your request and close the window, click **Cancel**.
4. When the desired term parameters are selected, click **OK** to close the Select Term window. GraphTool replots the graph according to the new term settings.

Changing the LDEVs on a graph

The Select Unit window allows you to change the LDEVs and replot a currently displayed graph.

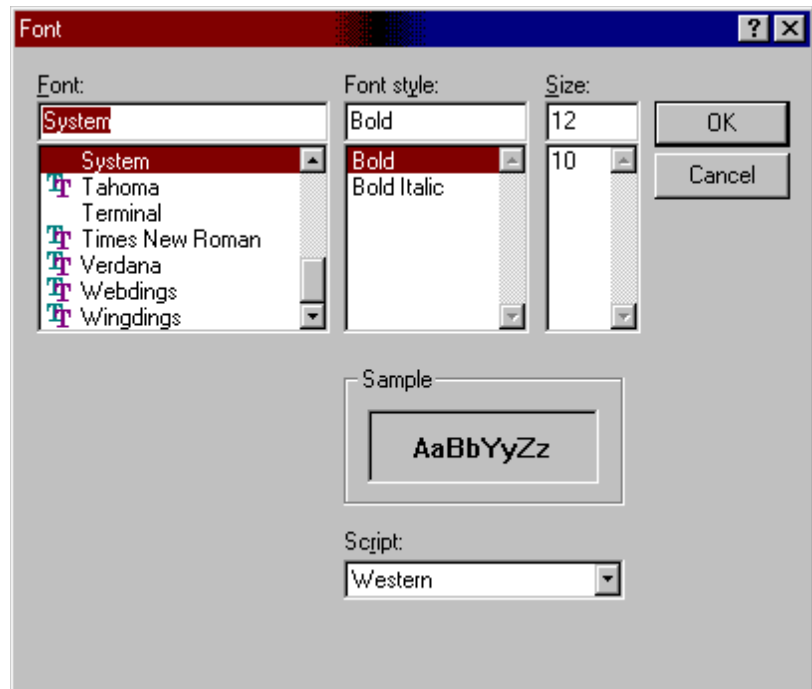


To change the LDEVs and replot a graph:

1. If more than one graph window is open, make sure that the desired window is active.
2. Open the Select Unit window by selecting **Unit** from the Configuration menu or by selecting the unit icon on the GraphTool main window.
3. Select the desired LDEVs in the **Select Unit** list box. To select all LDEVs, click **Select all**. To deselect all LDEVs, click **Clear all**. To check the appearance of the graph before closing the window, click **Preview**. To cancel your request and close the window, click **Cancel**.
4. When the desired LDEVs are selected, click the **OK** button to close the Select Unit window. GraphTool replots the graph according to the new LDEV settings.

Changing the font on the graphs

The Font window allows you to change the font properties for and replot a currently displayed graph.



To change the font properties for and replot a graph:

1. If more than one graph window is open, make sure that the desired window is active.
2. Open the Font window by selecting Font from the Configuration menu or by selecting the font icon on the GraphTool main window.
3. Select the desired font type, style, size, and script. To cancel your request and close the window, click **Cancel**.
4. When the desired font properties are selected, click **OK** to close the Font window. GraphTool replots the graph according to the new font properties.

Exporting data to text files

GraphTool allows you to export the usage data to text files. You can include the usage data in your word processor documents and spreadsheets and perform analyses of the usage data using your spreadsheet or database applications. You can export all data in the currently loaded **artlog.lzh** file, or you can choose to export only the data being displayed on a particular graph. The data is exported to tab-delimited text files.

The table below lists and describes the text files exported by GraphTool. Example GraphTool text files follow.

File Name	Description
CHP Utility.tsv	CHP usage rates
DKP Utility.tsv	DKP usage rates
DRR Utility.tsv	DRR usage rates
Disk Utility(ParityGroup).tsv	Parity group usage rates
Write Pending Rate.tsv	Write pending rates
Disk Utility(LDEV)_ParityGroupName.tsv One file per parity group. File name indicates parity group. Example: file name for parity group 2-9 is: Disk Utility(LDEV)_Grp2-9.tsv	LDEV usage rates
CSW-CMA Path Utililty.tsv	Adapter-CSW usage rates
MPA-SMA Path Utility.tsv	Adapter-SM usage rates
Map.tsv	Mapping between LDEVs and parity groups. This data is available for export only and cannot be graphed.

Example CHP Utility.tsv file

```
CHP Utility
Serial=30030(R400)
Plot mode=None
From=Wed Aug 30 17 15 00 2000
To=Fri Sep 08 09 30 00 2000
Step=900[sec]
time_tTimeCHP02-1PCHP03-1PCHP10-1Q
967655700Wed Aug 30 17 15 00 20001616 -0.1*
967656600Wed Aug 30 17 30 00 200018210
967657500Wed Aug 30 17 45 00 200020190
967658400Wed Aug 30 18 00 00 200019180
*A negative value means Auto LUN was not able to measure the usage
rate for that CHP.
```

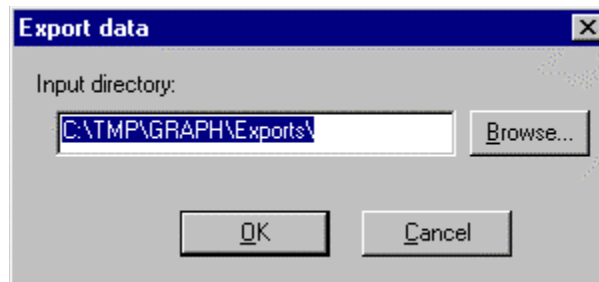
Example Map.tsv file

```
LDEV_PG Mapping
Serial=30030(R400)
From=Wed Aug 30 16:15:00 2000
To=Fri Sep 08 09:30:00 2000
MAP 967652100 Wed Aug 30 16:15:00 2000
LDEV Parity Group
7 A6Grp2-11
5 0EGrp2-10
:
6 0EGrp1-1
END
MAP 967918500 Wed Aug 30 17:15:00 2000
7 A6Grp2-11
:
6 0EGrp1-1
END
```

Graph data export procedure

To export the data in the active (selected) graph

1. On the GraphTool main window, select the **Option** menu, and then select **Export window data**. The Export Data window opens.
2. Specify the absolute path of the destination directory for the text file. You can enter a new directory or use an existing directory. To find an existing directory, click **Browse...**, locate the desired directory, and then click **OK**.



3. Enter the desired path and click **OK**. GraphTool starts exporting the data.

If the specified directory does not exist, GraphTool displays a confirmation message for creating the new directory. Click **OK** to create the new directory and continue.

If the TSV file already exists, a message appears asking if you want to overwrite the existing file. Click **Yes** to replace the existing TSV file, or click **No** to cancel your request to export data, and then specify a different destination directory.

4. When the export completion message appears, click **OK**.
The table on [page 114](#) lists and describes the text files exported by GraphTool.

To export all data in the currently loaded Auto LUN log file

1. In the GraphTool main window, select the **Option** menu, and then select **Export All** module data. The Export Data window opens.
2. In the Export Data window, enter the destination directory (absolute path) for the text files. You can enter a new directory or use an existing directory. Use the **Browse...** button to find an existing directory.
3. After entering the desired path, click **OK**. The Select Term window now opens. In the Select Term window, enter the desired range of data to be included in the text files, and then click **OK**.
4. GraphTool now displays a message asking if you want to skip saving the LDEV usage rates. The LDEV usage files can take a while to save for a subsystem with many devices. To skip the LDEV usage files, click **Yes**. If you want to save the LDEV files, click **No**.
5. If a TSV file already exists in the specified directory, GraphTool displays a message asking if you want to overwrite the existing file:

If you do not want to overwrite any existing TSV files, click **Cancel** to cancel your request to export data, and then repeat this procedure and specify a different directory on the Export Data window.

If you want to overwrite only the specified TSV file, click **No**.

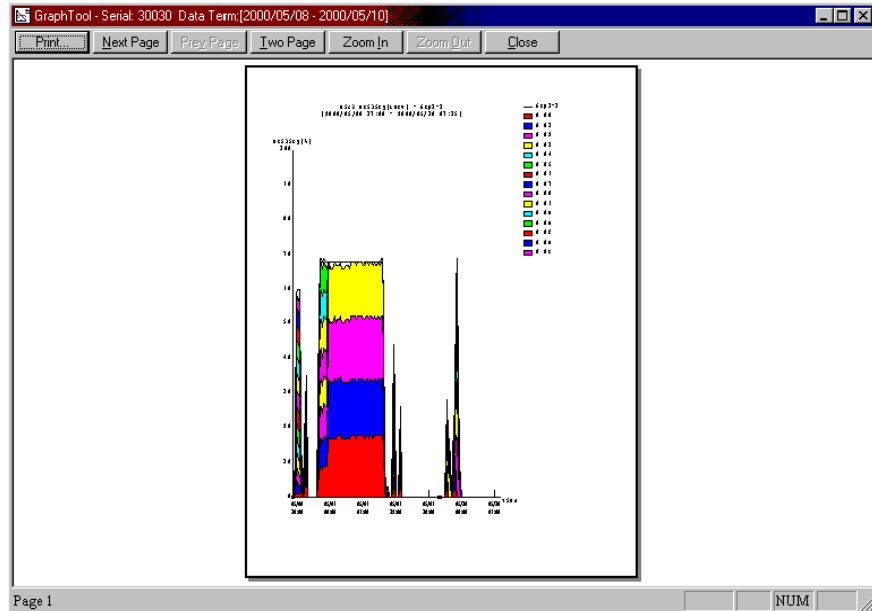
If you want to overwrite the specified TSV file and all other TSV files in the directory, click **Yes**.
6. When the export completion message appears, click **OK**.

Printing the graphs

GraphTool allows you to print the data graphs. You can also change the printer settings by selecting Print Setup from the File menu on the GraphTool main window.

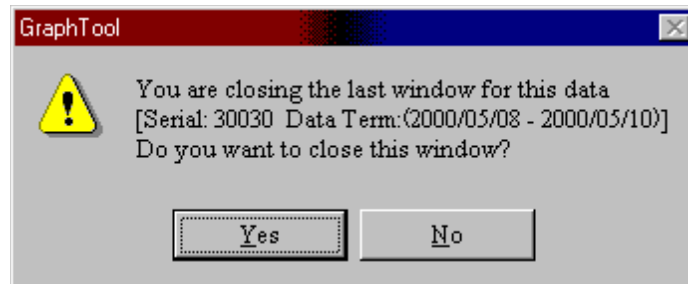
To preview and print a data graph:

1. If more than one graph window is open, make sure that the desired window is active.
2. If you want to display a preview of the print image, select **Print Preview...** from the **File** menu on the GraphTool main window. The Print Preview window displays one or two pages at a time and allows you to zoom in and zoom out. **Select Print...** to print the graph, or select **Close** to close the Print Preview window without printing.
3. If you closed the Print Preview window without printing, select **Print** from the File menu or select the print icon on the GraphTool main window to print the graph in the active window.



Closing the graphs

To close a data graph window, click the close button (X icon at the top right corner of the window). When you close the last window for the log data file which is currently open, GraphTool will also close the log data file. GraphTool displays a confirmation message for this operation. Click **Yes** to close the last window and also close the log data file. Click **No** to cancel your request to close the last window.



Troubleshooting

Troubleshooting can be performed by you or an HP service representative, depending on your HP service contract. The following information may help you resolve an error condition. If you are unable to resolve an error condition, ask your HP service representative for assistance.

Failure to make a plan

Auto LUN fails to create an auto migration plan when:

- There is no reserved volume in the same array of the same size, emulation type, or the same or adjacent class as the source volume
- The usage rate for the target parity group cannot be estimated, such as when the monitoring data is not valid
- The estimated usage rate of the target parity group exceeds the user-specified maximum
- The expected performance improvement is too small (less than 5%)

Failure to execute a plan

Certain conditions may prevent or stop a migration plan from executing:

- The current usage of the source or target parity group or volume is over the maximum disk utilization rate
- The current write pending rate for the disk array is 60% or higher
- A Continuous Access operation changes the volume status to something other than PSUS, PSUE, or SMPL
- A Business Copy operation changes the volume status to COPY or PSUS
- Monitoring data has not been updated since before the last migration

Error codes

The following Auto LUN error codes display on the remote console PC.

Code	Description	Recommended Action
0401	A locking timeout was detected during an internal processing. (A retry may result in a normal termination.)	Retry in about five seconds.
0801	Auto LUN could not be used.	Install the PP or the Auto LUN.
0810	The issued command was not accepted in this status. (The command was rejected.)	Check the pair status and confirm if the command is allowed to be issued.
0811	The issued command is treated as an NOP.	The issued command is treated as an NOP.
0830	A pair cannot be created because the track format is different.	Make sure that the emulation type of the source volume and target volume is the same.
0831	A pair cannot be created because a number of slots are different.	Make sure that the capacity of the source volume and target volume is the same.
0834	The emulation type of the specified source volume is not supported by the Auto LUN.	Make sure that the emulation type of the source volume is supported by Auto LUN.
0835	The emulation type of the specified target volume is not supported by the Auto LUN.	Make sure that the emulation type of the target volume is supported by Auto LUN.
0836	The pair cannot be created.	Confirms if the emulation type of the source and the target volume are the same.
0C70	The source volume is not installed.	Volumes not installed are not included in the object to be processed.
0C71	The source volume cannot be used.	Call the service personnel to make the source volume status normal.
0C72	The source volume is being formatted.	Wait until the formatting of the source volume completes.
<i>(continued)</i>		

Code	Description	Recommended Action
0C73	The source volume is a command device.	The command device does not execute Auto LUN function.
0C80	The target volume is not installed.	Volumes not installed are not included in the object to be processed.
0C81	The target volume cannot be used.	Call the service personnel to make the target volume status normal.
0C82	The target volume is being formatted.	Wait until the formatting of the target volume completes.
0C83	The target volume is a command device.	The command device cannot execute Auto LUN function.
0C90	The LDEV specified to be a Reserve volume is not installed.	Volumes not installed are not included in the object to be processed.
0C91	The LDEV specified to be a Reserve volume cannot be used.	Call the service personnel to make the volume specified as a Reserve volume a normal volume.
0C92	The LDEV specified to be a Reserve volume is being formatted.	Wait until the formatting of the volume specified to be a Reserve volume completes.
0C93	The LDEV specified to be a Reserve volume is a command device.	The command device cannot execute an Auto LUN function.
1009	The multiplicity of the Auto LUN exceeded its limit.	Delete some of the pairs.
1011	The number of the LDEVs specified to be a Reserve volume has already been used for a Reserve volume.	Change the LDEV number for specifying the Reserve volume.
1012	The number of the LDEV specified to be a Reserve volume has already been used for a primary LDEV of Business Copy.	Change the LDEV number for specifying the Reserve volume.
1013	The number of the LDEV specified to be a Reserve volume has already been used for a source volume of the hierarchical control.	Change the LDEV number for specifying a Reserve volume.
<i>(continued)</i>		

Code	Description	Recommended Action
1014	The number of the LDEV specified to be a Reserve volume has already been used for a target volume of the hierarchical control.	Change the LDEV number for specifying a Reserve volume.
1015	The LDEV specified to be a Reserve volume is not set as a Reserve volume.	Check the volume status.
1017	A Reserve volume cannot be set because the number of Reserve volumes allocated for them was exceeded.	Delete any of the Reserve volumes.
102B	The volume specified as Reserved was set as the Business Copy target volume.	Check the volume status.
102C	The specified source volume was set as the Continuous Access source volume.	Check the volume status.
102D	The specified target volume was set as the Continuous Access target volume.	Check the volume status.
102F	The specified source volume was set as the Auto LUN source volume.	Check the volume status.
1030	The specified source volume number does not exist.	Retry after refreshing the screen.
1031	The specified source volume was set as a Reserve volume.	Check the pair status.
1034	The specified source volume was set as another source volume.	Check the pair status.
1036	The specified source volume was set as the Business Copy source volume.	Delete the pair of the Business Copy.
1037	The specified source volume was set as a target volume of the Business Copy.	Delete the pair of the Business Copy.
103B	It is impossible to make a pair because Volume that was specified as a target volume is a Root Volume already.	It confirms a pair condition.
<i>(continued)</i>		

Code	Description	Recommended Action
103C	It is impossible to make a pair because Volume that was specified as a target volume is a Node Volume already.	It confirms a pair condition.
1040	The specified target volume does not exist.	Execute “Refresh” and do again.
1041	The specified target volume was not set as the Reserve volume.	Check the volume status.
1042	The specified target volume was used as another Auto LUN target volume.	Check the volume status.
1043	The specified target volume has been used as the Business Copy target volume.	Delete the Business Copy pair.
1046	The specified secondary LDEV is used as a P-VOL of Continuous Access.	Delete the Continuous Access pair.
1047	The specified secondary LDEV is used as a P-VOL of Continuous Access.	Delete the Continuous Access pair.
104A	The specified secondary LDEV is used as a source volume of the Business Copy.	Delete the Business Copy pair.
104B	The specified target volume was used as another Auto LUN source volume.	Check the volume status.
104E	The LDEV specified as a Reserve volume is being used as an M-VOL of Continuous Access.	Delete the Continuous Access pair.
104F	The LDEV specified as a Reserve volume is being used as an R-VOL of the Continuous Access.	Delete the HRC/Continuous Access pair.
1051	The LDEV numbers of the specified source and the target volumes are the same.	Retry after refreshing the screen.
1058	The volume specified as the source volume is a Continuous Access main/primary volume whose status is not suspended.	Check the volume status. Delete the Continuous Access pair or change the pair status to suspended.
<i>(continued)</i>		

Code	Description	Recommended Action
1059	The volume specified as the source volume is a Continuous Access remote/secondary volume whose status is not suspended.	Check the volume status. Delete the Continuous Access pair or change the pair status to suspended.
105A	The volume specified as the source volume is a Business Copy source/primary volume whose status is Split Pending.	Check the volume status. Delete the Business Copy pair or change the pair status so that the status is not Split Pending.
105B	The volume specified as the source volume is a Business Copy target/secondary volume whose status is Split Pending.	Check the volume status. Delete the Business Copy pair or change the pair status so that the status is not Split Pending.
1085	The source volume was used for the reserve volume of Auto LUN.	Check the source volume or cancel the reserve volume of Auto LUN.
1088	The specified reserve volume was set as Cache LUN.	Reset the Cache LUN extent.
1089	The specified source volume was set as Cache LUN.	Reset the Cache LUN extent.
108A	The specified target volume was set as Cache LUN.	Reset the Cache LUN extent.
108B	The specified reserve volume was constructed as LUSE.	Reset the LUSE configuration.
108C	The specified reserve volume was set as the Business Copy reserved volume.	Check the pair status. Select a different volume to be the Auto LUN reserve volume.

Contacting HP customer service

If you call HP customer support, provide as much information about the problem as possible, including the circumstances surrounding the error or failure and the exact content of any error messages displayed on the host system. You can use HP Remote Control XP on a remote console PC to check the R-SIM window and note the reference codes and severity levels of recent R-SIMs. For more information, see

HP StorageWorks Remote Control XP: User's Guide.

Glossary

ACP	Array control processor.								
AL	Arbitrated loop.								
AL-PA	Arbitrated loop physical address.								
BC	HP StorageWorks Business Copy XP. A software application that lets you create and maintain internal copies of logical volumes on the disk array.								
CA	HP StorageWorks Continuous Access XP. A software application that lets you create and maintain copies of data from a local disk array on a remote disk array.								
CHIP	Client-host interface processor. Channel interface processor								
DKC (disk controller unit)	The array cabinet that houses the channel adapters and service processor (SVP).								
DKU (disk cabinet unit)	The array cabinets that house the physical disks.								
DRR	Data recovery and regeneration.								
emulation modes	<p>The logical devices (LDEVs) in each RAID group can have one of the following emulation modes. The emulation mode determines the capacity of the LDEV.</p> <table><tr><td>OPEN-3:</td><td>2.29 GB</td></tr><tr><td>OPEN-8:</td><td>6.84 GB</td></tr><tr><td>OPEN-9:</td><td>6.88 GB</td></tr><tr><td>OPEN-E:</td><td>13.56 GB</td></tr></table>	OPEN-3:	2.29 GB	OPEN-8:	6.84 GB	OPEN-9:	6.88 GB	OPEN-E:	13.56 GB
OPEN-3:	2.29 GB								
OPEN-8:	6.84 GB								
OPEN-9:	6.88 GB								
OPEN-E:	13.56 GB								

OPEN-K:	1.74 GB	<i>(XP48/XP256/XP512 only)</i>
OPEN-L:	33.94 GB	
OPEN-M:	43.94 GB	<i>(XP48/XP256/XP512 only)</i>
OPEN-V:	60.0 GB	<i>(XP128/XP1024 only)</i>

FC-AL	Fibre Channel arbitrated loop.
HBA	Host bus adapter.
HP	Hewlett-Packard Company.
host mode	Each port can be configured in one of various host modes. The host mode determines the array's behavior toward a specific host.
LDEV	Logical device. An LDEV is created when a RAID group is divided into sections using a host emulation mode (for example, OPEN-9 or OPEN-M). The number of resulting LDEVs depends on the emulation mode. The term LDEV is often used synonymously with the term volume.
LUN	Logical unit number. A LUN results from mapping a SCSI logical unit number, port ID, and LDEV ID to a RAID group. The size of the LUN is determined by the emulation mode of the LDEV, and the number of LDEVs associated with the LUN. For example, a LUN associated with two OPEN-3 LDEVs will have a size of 4,693 MB.
LUSE	Logical Unit Size Expansion, a feature which logically combines LDEVs so they appear as a larger LDEV. This allows a LUN to be associated with 2 to 36 LDEVs. Essentially, LUSE makes it possible for applications to access data requiring a large amount of disk space.
MB	Megabytes.
MPE	Maximum physical extent.
OFC	Open Fibre Control.
OPEN-x	A general term describing any one of the supported OPEN emulation modes (for example, OPEN-3, OPEN-9, OPEN-L, etc.). Supported emulation modes: OPEN-3/8/9/E/L.

XP48
XP256
XP512

OPEN-K/M are also supported.

XP128
XP1024

OPEN-V is also supported.

PA

Physical address.

port

The number of ports on an XP disk array depends on the number of supported I/O slots and the number of ports available per I/O adapter. The XP family of disk arrays supports Fibre Channel and SCSI ports. *I/O support may vary with the selected disk array.*

Ports are named based upon their port group and port letter. Examples of port names include CL1-A through CL1-R and CL2-A through CL2-R (letters I and O are skipped).

P-P

Point-to-point.

RAID

Redundant array of independent disks.

RC

HP StorageWorks Remote Control XP, a software product used for managing XP arrays.

remote console PC

The PC running HP StorageWorks Remote Control XP.

R-SIM

Remote service information message.

SCSI

Small computer system interface.

SIM

Service information message.

SNMP

Simple Network Management Protocol.

SVP	Service processor. A notebook computer that is built into the disk array. The SVP provides a direct interface into the disk array. The SVP is reserved for the HP use only.
TID	Target ID.
VSC	Volume Size Configuration.

A

- audience
 - intended 7
- authorized reseller, HP 10
- Auto LUN
 - description 16
- Auto LUN main window
 - description 39

C

- conventions
 - documentation 8

D

- disk arrays
 - supported 7
- disk usage
 - setting maximum 61
- documentation
 - conventions 8
 - related 7

E

- estimate
 - functional description 20
- Excel
 - installation 76

exporting

- extracting monitor data from export file 91

F

- font for GraphTool graphs 113

G

- Glossary 129
- graphs
 - making Excel 77
- GraphTool 118
 - changing the font for graphs 113
 - changing the graph parameters 111
 - closing graphs 119
 - displaying the graphs 97
 - exporting usage data to text files 114
 - extracting log file data 87, 91
 - highlighting data on a graph 109
 - installing and uninstalling 82
 - installing and using 79
 - main window 87
 - printing a graph 118
 - saving a graph 105
 - selecting the data module 100
 - selecting the data term 102
 - selecting the LDEVs 104
 - selecting the parity group 101

- starting and exiting 86
- version 84
- version information 84
- viewing the graphs 105

H

help

- obtaining 9

history log

- entry format and fields 72
- viewing auto migration 71
- viewing manual 70

HP

- authorized reseller 10
- storage website 9
- technical support 9

HP customer service

- contacting 128

I

I/O statistics 81

installation

- deinstalling 36
- preinstallation 30
- procedure for XP256 33
- procedure for XP512 34

L

LDEV-specific data 81

M

migration

- by preset function 28
- canceling auto plan 69
- checking manual status 54
- making new automatic plan 67
- performing automatic 56
- performing manual 49

- setting schedule 64

- setting time 64

- starting manual 51

- stopping manual 55

- viewing history 70

monitor term

- selecting 44

monitoring

- functional description 17

- operations 42

- stop and start 42

MP usage 80

O

operations

- requirements 31

- restrictions 31

P

parity group

- setting fixed 60

plan

- making 25

Printing graphs 118

R

related documentation

- list of 7

S

setup.exe 82

system administrator

- required knowledge 7

T

technical support

- HP 9

text files, exporting usage data to 114

- troubleshooting
 - HP customer support 128

V

- volume
 - reserving 47
- volume moving
 - functional description 20
- volume usage rate
 - viewing 46

W

- websites
 - HP storage 9

